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CONTENTS.

Editorial 469
Tesla Split-Phase Patents 472
A. I. E. E. Philadelphia Local Meeting 472
Chicago Meeting of the A. I. E. E. on Car Lighting 472
Formal Opening of the Frontier Independent Telephone Exchange in Buffalo, N. Y. By Frank C. Perkins 473
The Testing of Recording Wattmeters on the Consumers' Premises by Means of a Specially Constructed Portable Test Meter. By W. J. Mowbray 475
System of Electric Control for New York Subway 477
The Heyland Induction Motor—*Concluded.* By Boy De la Tour 479
Electric Railways in Sweden. By Arvid Westerberg 481
Meeting of Independent Telephone Association of Maine 482
American Electrochemical Society 482
Reasons for Travel Congestion in New York 482
Recent Electrochemical Developments. By Clinton Paul Townsend 483
Dutch Cable Landing at Guam 483
New Telephone Patents 484
Proposed Municipal Lighting Plant for New York 485
Current News and Notes 485
LETTERS TO THE EDITORS:
Tesla Split-Phase Decisions. By William Stanley 486
The Mercury Arc. By Louis E. Walkins 486
Fuel Consumption in Central Stations. By Jos. E. Lockwood 486
Digest of Current Electrical Literature 487
New Books 491
A Notable Invention in Rapid Telegraphy. By Romyn Hitchcock 492
"Sparklet" Fuses 493
Interruptions of the California Long Distance Power Service 493
The Felt Axle-Driven Train Lighting System 494
Monorail Railway 495
General Electric Motor for New York Subway 495
Electrical Contracts in the Philippines 497
New Electric Automobiles 497
DEPARTMENTS:
Financial Intelligence 498
Commercial Intelligence 499
General News 501
Trade Notes 505
Record of Electrical Patents 506

A NEW YORK MUNICIPAL PLANT.

We are not surprised that the idea of a New York municipal lighting plant should have been presented recently to the public of this city. The thing has been talked about before, especially under the Tammany régime, and it did look the other day as though the "municipal ownership convention," held under the nominal auspices of the Reform Club, might have a "joker up its sleeve" of some kind or other. Perhaps the convention and the attack on the lighting corporations have had nothing to do with each other; but it is a little curious that so much time and rhetoric should have been given to the iniquities of private gas and lighting plants. Looking back at the discussions of a week or two ago, it does seem as if whatever was left unsaid against the companies was now being voiced by Commissioner Monroe and other civic authorities in their eagerness to create a new municipal bureau.

Granting the good faith and public spirit of the city administration in the move now being made, we can but regret this effort to erect a new department to handle large sums of public money and employ large numbers of voters. If there be an evil that is aimed at, the remedy is worse than the disease. We do not see how the new plant could possibly be got into operation under two or three years, by which time, according to the normal ebb and flow of politics, it would fall into the hands of those who have, it is asserted, often looted the city treasury through the public departments. On Monday morning of this very week, while the papers were full of the new municipal lighting project, they also published extracts from the City Club's pamphlet on the rottenness in the Board of Health. We will make no comment, but just quote the following:

Persons who made special investigation of the matter charged that the average blackmailing by officials of the Health Department amounted to fully $1,500,000 a year. If, for instance, a manufacturer could save $2,000 a year by burning soft coal, he could afford to have his violation of the smoke ordinance overlooked. It was well understood by property owners that they could regularly escape making repairs ordered by the payment of a bribe equal to 25 per cent. of the estimated cost of the work. If the case were such that the conditions demanding remedy could not be ignored, or if the owner decided that it was to his interest to do the work required, it was suggested to the owner to employ a certain firm recommended by the officials of the department. The charges of the firm were exorbitant, but experience convinced owners that it was cheaper in the long run to act on the "recommendation." The two presidents of the Board of Health during Mayor Van Wyck's administration, Michael C. Murphy and his successor, John B. Sexton, were typical specimens of the spoils politician. Neither knew anything of the real duties of such a position.

There is a lot more of the same kind in the report. Yet, in view of such allegations, another set of reformers actually proposes to saddle on the community a new department vested with all manner of opportunity for waste, blackmail, bribery and corruption.

In addition to the proposal that the new plant shall supply city lights, men of socialistic bent like Comptroller Grout, say that it should supply electricity to all the residents of New York. We believe that city lighting is about 5 per cent. of the New York Edison business, so that the ultimate investment of public money proposed by Mr. Grout is simply enormous; while the proposed profit or saving is as usual based apparently on erroneous figures like those of Detroit or the prices of little towns and villages where a square foot of land costs one dollar instead of six hundred. If the city does not go into the wholesale production of current, it is merely

going to produce at retail a little five per cent., and before it does that, the part of wisdom and prudence demands that every possible step be taken to secure better terms from existing private plants. As against the socialistic municipal-ownership-of-everything craze, we cannot do better than quote the *New York Sun* when it says, in language echoed by other newspaper leaders of public opinion: "With the fullest precedents at hand for legislative regulation of the New York city gas companies, the movement, or rather the threat, to establish a municipal lighting plant is plainly not for the redress of grievances, but to get the city into the business of making light. The agitation started yesterday was started by the restless spirit of municipal ownership. There is more against that system than overburdening the government with responsibility for functions that are better served by private enterprise. The municipal ownership advocate is a load on industrial confidence and prosperity. His voice is a signal to every business company successful enough to be conspicuous that its business is in danger. The municipal ownership man is envious of it and wants to seize it. In his devotion to his hobby he longs to narrow the field wherein ordinary citizens may make a living. Trouble between the city and the gas companies will be much better adjusted by business men than by doctrinaires."

THE SYNDICATE IDEA.

This is the day of syndicates and consolidations, but it is only recently that the movement seems to have started actively among small electric light and power plants. It is rather strange, in view of the tendency of the times, that this idea has not been worked more extensively heretofore as regards small electric lighting properties. Probably the reason for this is that since the gross receipts from these small enterprises are small per company, there has not been the temptation for men of large affairs to attempt to bunch together a large group of them under one management, that there would have been if a similar gross income could be obtained from a smaller number. We have had in this country for several years a number of prosperous companies or syndicates controlling a number of electric lighting and railway properties under one general management. Most of these properties have been in moderate-sized cities of 30,000 to 125,000 population. They have usually been scattered from Maine to California, and with executive offices located in the East, as they usually are, the traveling expenses of administration are high. When we come to towns of 10,000 or less, while there is profit in well-managed electric light and power business, there is not sufficient money turned over in the course of a year to make the handling of such properties attractive to a company or syndicate located a thousand or several thousand miles away. However, it is beginning to be realized that even if such small plants cannot be handled to advantage by syndicates of national scope, there is a good opportunity for a consolidation of management of small plants located within a radius of 300 miles of a general office. By getting together a sufficient number of small plants within such a radius, the expenses of engineering and administration, and much of the expense of bookkeeping, can be reduced to an amount per plant consistent with the gross income per plant.

One of the greatest difficulties with which the smaller electric light and power company labors is lack of efficient engineering and management. This lack the syndicate idea makes good. It is not to be expected, of course, that the fact that a plant is operated by some central company will for a moment make up for the absence of a good man in local charge of each plant; but the central management is likely to insure such a competent man being placed in charge, for the reason that inefficient local management would probably not be borne with as long by a syndicate as by local interests owning a plant. Of course, there is the objection that there is likely to be less friendly feeling in a community for an outside corporation than for a company composed of local people. There is another side to this case. A company controlled by local parties is apt to show undue favoritism in the way of prices to some of the company's customers, because of local business and political reasons, much to the detriment of the revenue of the plant. With outside local management this would probably be wiped out, and all customers would be put on a fair and equitable basis.

In effecting such a consolidation of such plants, it is not essential that local interests be purchased outright. It may even be possible in some cases to exchange stock in the local companies for stock in the consolidated company, leaving the local stockholders as stockholders in the consolidation, rather than stockholders in one individual plant. If the consolidation is controlled by men having the confidence of the various local capitalists, there would seem to be many excellent reasons why stock in such a consolidated company would be worth more and have a more stable value from an investor's standpoint than the stock in any one local enterprise. On such a basis as this many small plants could be established or extended, where now they either languish or do not exist.

THE HEYLAND MOTOR.

We print in this issue the concluding part of the chapter on the Heyland motor from the excellent work on the "Induction Motor" by Boy De la Tour, which book has recently been translated into English by Mr. C. O. Mailloux. Much has been written about this interesting self-regulating and automagnetizing type of asynchronous induction motor, but thus far it appears to exist only on paper. It is apparently beyond dispute that the machine should be able to maintain a power-factor of unity over its ordinary working range of torque, but only through sacrificing that condition which made the induction motor pre-eminent—namely, the absence of a commutator. The induction motor, in spite of its small mechanical clearance, is a wonderfully reliable machine and can stand magnificent abuse. It has a pair of self-oiling bearings, and some primary terminals. When these terminals are connected to the mains through a suitable starting switch and transformer, the machine will start and go on running. There is nothing to be done save to see that the oil in the bearing is changed at long intervals. The machine takes, however, a fairly strong wattless component of magnetizing current, and is objectionable to the station manager from that standpoint. If, however, in order to eliminate the large magnetizing current, a commutator and brushes have to be added to the machine, the ideal simplicity of the motor is rudely dispelled and the question becomes one of choice between additional cost, complexity and inspection, with very little magnetizing current, or the original sin of much magnetizing current linked with a nature of guileless simplicity.

TESTING OF RECORDING WATTMETERS ON CONSUMERS' PREMISES.

Mr. Mowbray's article, on page 475 of this number, deals with a subject of much importance to the central station manager. It is appalling to contemplate the total loss of income which a distributing system incurs, consequent upon a definite tendency of the consumer's meters to under-register at light loads. When adequate capital is available, it is wonderful how much first cost may logically be debited to a theoretically accurate meter, in order to avoid the loss of income which inaccuracy of friction at light loads may involve. It is almost a self-evident proposition that meters should be tested in place. Not only is serious objection raised to the frequent changes of meter that testing at the station involves, but also the

transport and restoration of a meter may involve mechanical hardships to the instrument, in the hands of over-vigorous employees, sufficient to alter the rate. Mr. Mowbray's plan for testing is to use a peripatetic standard meter essentially similar to the meter tested, on the principle of "set a thief to catch a thief." This is certainly a better plan than the conjoint use of voltmeter, ammeter and slide-rule. It is perhaps the cheapest plan that could be devised, for it avoids numerical labor and employs a relatively inexpensive measuring instrument.

The method as described is, however, only applicable to meters in which the cover may be lifted for interior inspection. Permanently sealed meters require the slide-rule or equivalent arithmetical processes in testing. In such cases a portable indicating wattmeter, as distinguished from a watt-hour meter, is perhaps preferable. Some day we may see a standard form of house-service switch and fuse-block, for installation in the neighborhood of the meter, and in which a simple but effective attachment will be provided for the ready insertion of the testing watt-indicator. This, with a portable rheostat for adjusting an artificial load, would make it possible for an assistant to apply and maintain the full-load power, or any fraction thereof; while the inspector counts the revolutions per minute of the meter tested, with a stop-watch, and determines the rating. This would only differ from Mr. Mowbray's plan in the use of a more delicate and expensive form of testing instrument. The process might be worked out so as to avoid computations. By special design, one and the same wattmeter might be made to measure very varied ranges. This might be done with shunts. With any regularly organized testing system, the electric meter is capable of being tested in place more conveniently, swiftly and accurately than any other meter for house installation. Gas meters and water-meters are much more troublesome to test.

A TWENTIETH CENTURY PROJECT.

An important document comes to light in our current issue in the form of a project for the electric operation of all the railways of Sweden. That country has already been the scene of large activity in power transmission operation, and considering the lack of an adequate coal supply even for operating the railroads, there is good reason for working the water powers to their utmost. The present project contemplates the operation of the national railway system by electric traction, ultimately in its entirety. At first only sections would be transformed and then as locomotives needed replacement electric locomotives would take their place, so that without the burden of an immediate heavy investment, and without the scrapping of valuable material, the change will be made complete. It is proposed to press into service both water powers and the extensive peat beds that are here and there found and which lie scattered, so that by utilizing both sources the distances of transmission will not be excessive even from the standpoint of present practice. Mr. Dahlander, the engineer who has made the preliminary report, figures out a net annual saving of about two million dollars a year by the change, a sum approximately equal to the entire motive power expense on the electrical system; and in addition the importation of coal for railway purposes will become unnecessary, which from the governmental standpoint is very desirable.

The project as a whole strikes one as singularly sane and reasonable. It does not attempt the extraordinary, nor does it pass beyond the conservative limits of present practice. In fact it is conspicuous for the absence of sensational features of any kind. Even in the system of motive power proposed it does not indulge in radical novelties, but proposes tentatively at least, the Ward Leonard scheme recently developed by the Oerlikon Company. Now this plan, whatever may be said of its complication in apparatus, has at least the merits of involving no broadly experimental features, and of giving a most reliable and perfect speed control. Besides it lends itself very readily to installation in company with steam locomotives and involves no radical changes in methods of operation. The polyphase traction systems Mr. Dahlander turns down on the ground of complication, more especially in the overhead system. This of itself strikes us as a less serious objection than the matter of speed control, which assumes particular importance when a gradual conversion to electric traction is attempted. The Ward Leonard plan is remarkably well suited to meet this very case, although Mr. Dahlander does not seem to forget the Arnold and Lamme-Westinghouse devices, which we hope ere long to see tried out on a decisive scale in this country. If the latter plan succeeds it certainly will work a revolution in power transmission as well as in railway work, for if a big railway motor on the series single-phase system can be made to work as well as Mr. Lamme assumes, similar motors will *a fortiori* be important in ordinary distribution whatever system may be used for the transmission line. All this, however, remains to be proved, and Mr. Dahlander very sensibly bases his preliminary estimates on a system that certainly will do the work even if slightly less economical in its use of power than a system with alternating motors upon the cars. At all events, the low-tension working conductor must go if serious railway work over long distances is to be a success.

In this connection we cannot help running over the form this Swedish project would have taken if treated on our canonical and case-hardened American lines. Would it show a mighty trolley wire or the third rail? Of course there would be scores of sub-stations with rotaries—nice, steady-going, low-speed rotaries all thoroughly standardized and fed from giant transformers to match. There would be also a beautiful multiple unit control and as many motors per train as the Swedish treasury could pay for. There would be special provision for quick acceleration—no up-to-date engineer would tolerate less than enough to throw the passengers through the rear door in stopping. Jesting aside, it would not be very cheerful to have the first great application of electricity to general railroading made abroad by an American method which had been without honor in its own country, and which American engineers had lacked the initiative to apply. It is interesting to note in this connection that the Ward Leonard system has also met with favor in the land par excellence of electrical engineering—Switzerland—where it is being developed with a view to its application on all Swiss government roads to the entire exclusion of the steam locomotive. We have done marvels in this country in the development of electric traction for certain purposes and along certain canonical lines, but though the larger work has been discussed and proposed nothing has yet come of it. There is a great gap that yawns between the best and most extensive interurban road and the most modest of railway systems. Not long ago we had occasion to comment on a paper by Mr. Vanderbilt dealing with this larger problem of electric traction. From his standpoint the outlook was not encouraging, and it is safe to say that it will remain discouraging until we are ready to cut our coat according to the cloth and treat a trunk line as a distinct entity having characteristics of its own and not merely as a bigger street car line to be operated in the good old way or left to its fate. We trust that the Swedish project will be pushed to a final development and to construction, though it is a bit annoying to think of the first point being scored away from home.

Tesla Split-Phase Patents.

Judge Colt, of the United States Circuit, District of Massachusetts, on March 11 handed down a decision covering the Tesla split-phase patents, the parties to the suit being the Westinghouse Electric & Manufacturing Company and the Stanley Instrument Company. The opinion, which is very brief, refers to the recent decision of Judge Townsend in a suit on appeal in which the same patents were involved, an account of which is given in our issue of March 7.

The opinion states that upon careful consideration of the evidence, the court has reached the conclusion that the complainant has failed to establish, by sufficient proofs, the conception by Tesla of the inventions in suit prior to April 22, 1888, the date of the Ferraris publication. In a complainant's supplemental brief no reasons were found stated or authorities cited which should lead the court to any different conclusion. Since the hearing in case at bar, the Circuit Court of Appeals for the Second Circuit, in a suit involving the same patents brought by the complainant against the Catskill Illuminating & Power Company, upon the same evidence which was before the present court, has held that the proofs were insufficient to establish invention by Tesla prior to April 22, 1888. Judge Colt considers that this decision, which was passed down February 26, 1903, renders unnecessary an extended opinion by him, since it would be only repetition of the views so clearly expressed by Judge Townsend in the opinion of the court in the Catskill case. A decree would be entered dismissing the bill, with costs.

A. I. E. E. Philadelphia Local Meeting.

The first regular meeting of the Philadelphia local meeting of the American Institute of Electrical Engineers was held at the Engineers' Club, 1122 Girard Street, Monday evening, March 9. There was a short business session during which Mr. Carl Hering was elected chairman, Mr. H. F. Sanville, secretary, and Messrs. Charles Hewitt, W. C. L. Eglin, J. F. Stevens, H. A. Foster and Theodore Spencer members of the Executive Committee.

Mr. W. L. Bliss then presented his paper on "Railroad Train Lighting," and Mr. W. C. L. Eglin presented abstracts of the papers of Messrs. Farnsworth and Sperry, on the same subject. A spirited discussion was opened by Dr. C. B. Dudley, of the Pennsylvania Railroad Company, and carried on by Messrs. W. L. Bliss, Hugh Lesley, C. J. Reed, H. C. Spalding, J. B. Klumpp and others. The remarks of the several railroad men added very largely to the interest and value of the discussion.

The next meeting of this branch will be held on Monday night, April 6.

Chicago Meeting of the A. I. E. E. on Car Lighting.

One of the most enjoyable and enthusiastic meetings of the American Institute of Electrical Engineers at Chicago was held Tuesday evening, March 10, at the rooms of the Western Society of Engineers. The main idea of this meeting was to increase acquaintance among members and prospective members of the Institute in Chicago and increase interest in the Institute meetings. An hour was given to the consideration of train lighting and a very profitable discussion resulted.

The discussion was started by Mr. C. Lock Etheridge, until recently electrical engineer of the Pullman Company. Mr. Etheridge has had considerable experience in equipping the cars of that company with various systems of lighting. He did not attempt to take up the merits and demerits of various systems described in the papers, but spoke rather from the operating standpoint in general. He criticized the lack of care given by the majority of railroads to their train lighting equipments. He cited one case in particular as an example, where a dining car running about three hundred miles a day had been out of the shops about three months when its axle-driven lighting system was reported to be in trouble. Upon investigation, Mr. Etheridge found that the belt driving the dynamo from the car axle was gone. Further investigation convinced him that absolutely no attention had been given to the electrical lighting apparatus in this dining car in the three months it had been out. This was shown by the fact that various adjustments of wires and the adjustment of the belt tension had not been disturbed. The belt had not been tightened in that time and when finally it was lost off and the storage battery was run down, of course there was trouble. He thought that a system that would run three months without any attention was not very bad. Considering the attention given to electrical equipments, he thought that the wonderful thing was not that there was so much trouble with them, but that there was so little. The car wiring done by many of the railway companies which do their own wiring was much of it very bad; in fact, no better than bell wiring. Wires were run fastened to woodwork by staples and a common return system used. It was nothing uncommon to be able to light all the lamps in a car by turning the switch which was supposed to control but one circuit. He regretted that the paper by Mr. Sperry had been presented to the Institute, as it gave absolutely no information as to what the new system spoken of really was, and might better have been omitted.

Mr. A. J. Farnsworth, author of the paper on the "Consolidated" axle lighting system, seconded Mr. Etheridge's criticism of ordinary train wiring, and said that in reality wiring of railway cars should be better than any other class of wiring, because of the constant vibration, which would in time break down anything but the most substantial construction. There was room for a great deal of work in standardizing junction boxes outlets and similar fittings. He favored a low voltage (thirty volts) because high-efficiency lamps taking 2½ watts per candle-power were possible by using the low-voltage lamps with thick, short filaments. High efficiency was desirable so as to get as much light as possible from a given weight of battery. He also favored standardizing train connectors.

Mr. Gillman, of the Chicago, Milwaukee & St. Paul Railway, said that there was some good train wiring, and in spite of the poor help employed by many railway companies, there was lots of good train lighting. He had taken great pains with the wiring of cars under his charge and had had but little trouble, even though much of the wiring was the molding work which had just been criticized. He favored wiring cars on the three-wire system, with 110 volts across the outer mains. When necessary, it could be switched over to operate on the two-wire system at half the voltage, and it would then work in parallel with the sixty-volt systems which are common. This would permit the use of sixty-volt lamps, which would be of higher efficiency than 110-volt lamps, and would stand the jarring of the train better, and it would permit storage batteries to be charged in cases of emergency from 110-volt circuits, which could be found at many places along the line of a railroad. Where a private car doing special service is taken from the regular equipment, this ability to charge at any important stations along the line, is desirable. This applies more particularly, of course, to systems using a dynamo in the baggage car. He favored the three-wire system also because of the drop in voltage on a long train where current is furnished from a generator in the baggage car.

Mr. D. Avery Kimbark, who has had extensive experience in the installation of car lighting systems for the Pullman Company, considered the use of thirty-volt lamps inadvisable, even with axle-driven systems, because of the drop in voltage on long 90-ft. cars, where, as is usually the case, the controlling panel must be placed at one end. A low voltage was sometimes favored because of the small number of storage cells it required, but the battery on the car must be large anyway to provide a sufficient reserve, and the number of cells required by a sixty-volt, as against the thirty-volt system, would not be as undesirable as it would if the battery were smaller. The Pennsylvania Company, after many years' experience, has adopted sixty volts. As to car wiring, he thought Mr. Gilman's cars wired in molding gave satisfaction, because of the close personal attention he gave to them. Much of the car wiring on railroads is undoubtedly very bad. Cars were frequently wired on a common return system. He had seen some cars wired with cotton-covered magnet wire, several circuits twisted together and fastened under one staple. Of course this was a common return system. He referred to a constant-speed axle system, devised by Mr. Charles E. Felt.

L. F. Mahler showed some lantern slides illustrating the application of a De Laval steam turbine to the driving of train-lighting generators. One of the Pennsylvania limited trains is lighted by a turbine-driven generator in the baggage car and orders have been placed for several more of these equipments.

Mr. R. H. Pierce, local secretary, tendered his resignation as he will move to Boston on May 1 to open an office in that city. The loss of his services is deeply regretted.

Formal Opening of the Frontier Independent Telephone Exchange, Buffalo, N. Y.

BY FRANK C. PERKINS.

THE Frontier Telephone Company, of Buffalo, had a formal opening of its new exchange on Ellicott Street, on Tuesday, March 10. In response to invitations sent out by the officials of the company the building was crowded from 2 P. M. to 10 P. M., and the day was set aside for public inspection, the visitors being received by Vice-President William A. Douglass, Assistant General Manager Willbur H. Johnston and others. The accompanying illustration, Fig. 1, shows the office building and exchange, the interior of which was profusely decorated with flowers, on this occasion, while numerous selections were rendered by an orchestra on the first floor and refreshments were served in the operators' parlors and dining-rooms on the third floor. A complete kitchen equipment has been provided by the company for the operators, as well as library and sitting-rooms, together with well-arranged lockers, wash rooms and an elaborately furnished hospital.

The president of the Frontier Telephone Company is E. C. Lufkin, the secretary and treasurer, Charles B. Hill, and the general manager, Samuel E. Wayland. The main switchboard and electrical equipment of the exchange is located on the second floor, the first floor being given up to offices and store rooms in the rear.

FIG. 1.—FRONTIER TELEPHONE EXCHANGE.

The current for operating the exchange is exclusively obtained from the Buffalo General Electric Company, but an independent gas engine plant has been provided for use in case of failure of the Niagara power. The electrical generators, Fig. 2, and motor generator sets were supplied by the Holtzer-Cabot Electric Company, the gas engine equipment by the Westinghouse Company, and the telephones and switchboards (Fig. 3) by the Kellogg Switchboard & Supply Company, of Chicago, while the storage battery plant was installed by the National Storage Battery Company, of Buffalo.

The storage battery room is equipped with two sets of accumulators consisting of 11 cells each, the present capacity of the 4 positive and 5 negative plates being 800 amp-hours, while the output can be doubled when desired by increasing the number of positives to 8 plates and adding 5 more negative plates. These cells are of the National type and are 33 in. long, 23 in. wide and 19¾ in. deep. The power switchboard seen in the accompanying illustration consists of three panels, the first of which is equipped with Weston instruments, the voltmeter reading from 0 to 3 volts for testing the individual storage cells. The second panel is equipped with the distribution switches and a Weston voltmeter reading from 0 to 50 volts. The third or charging panel is supplied with two circuit-breakers, one for each battery, together with a Weston ammeter reading up to 250 amp and the usual switches.

The batteries are charged by two motor-generator sets of 10-hp capacity each, one being held in reserve in case of emergency. These groups noted in the background of Fig. 2 operate at 1,000 r.p.m. The motor receives its current from the General Electric service at 220 volts, taking 10 amp, while the dynamo supplies a direct current of 175 amp and 30 volts, the latter being raised as the cells become charged. The motors and generators of these sets are of the Holtzer-Cabot four-pole type. In case it is necessary, the batteries may be charged from the gas engine plant located at the right in Fig. 4.

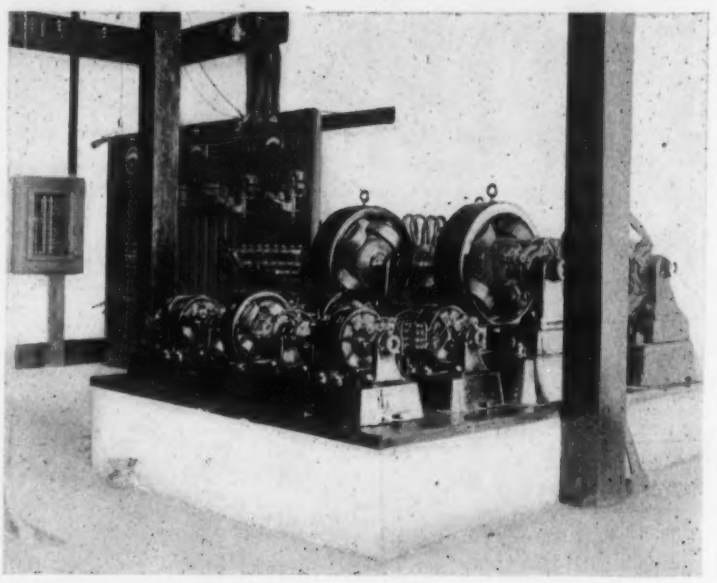


FIG. 2.—CHARGING MOTOR-GENERATORS, RINGING MOTOR-GENERATORS AND POWER SWITCHBOARD.

This installation includes a Westinghouse twin-cylinder vertical gas engine of 15-hp capacity, the cylinders being 6 x 8, and the speed 350 r.p.m. The engine is connected to a four-pole Holtzer-Cabot dynamo by a chain drive, the speed of the latter being 915 r.p.m. This direct-current auxiliary generator has a capacity of 5¼ kw supplying a current of 175 amp at a pressure of from 30 to 80 volts. This outfit may be utilized for charging the accumulators or operating lights as desired.

One of the most interesting apparatus in the exchange is the direct-alternating current ringing motor-generator sets seen in the foreground of the accompanying views (Figs. 2 and 4). These ringing machines are for the four-party lines and consist of two groups with

FIG. 3.—SWITCHBOARD.

five machines in each group connected by a common shaft. One set is held in reserve and may be operated from the storage battery, the motor in the center of the group being wound for 24 volts, while the other set is driven by Niagara current from the 220-volt power service of the Buffalo General Electric Company. These ringing machines and the wiring are arranged for supplying the current for the selective or individual ringing. The direct-current motor in

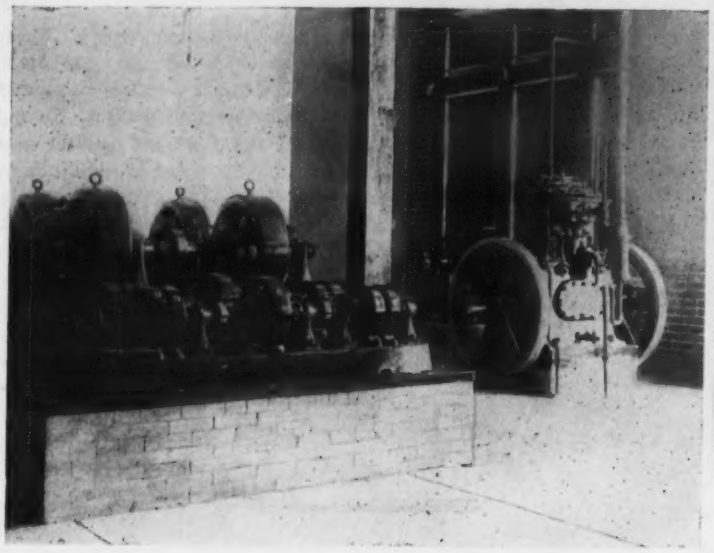


FIG. 4.—CHARGING AND RINGING MOTOR-GENERATORS.

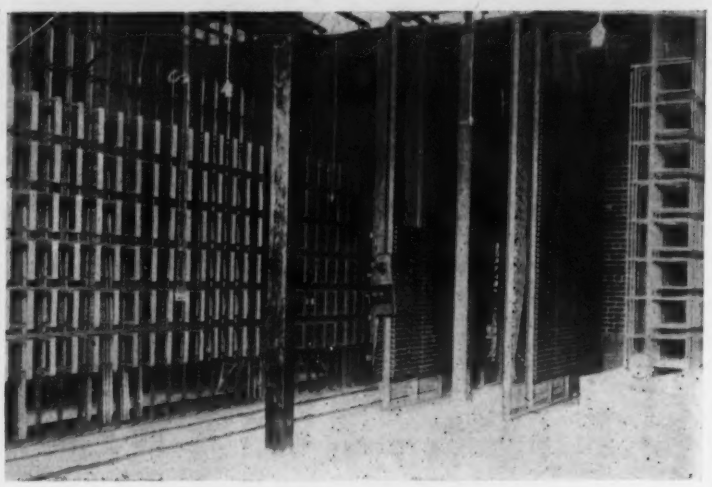


FIG. 5.—RELAYS AND REAR OF DISTRIBUTION RACK.

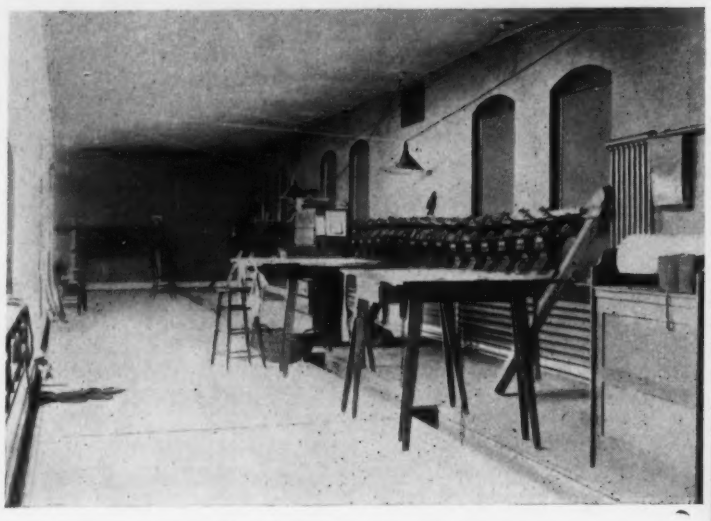


FIG. 6.—OPERATORS' PRACTICE ROOM.

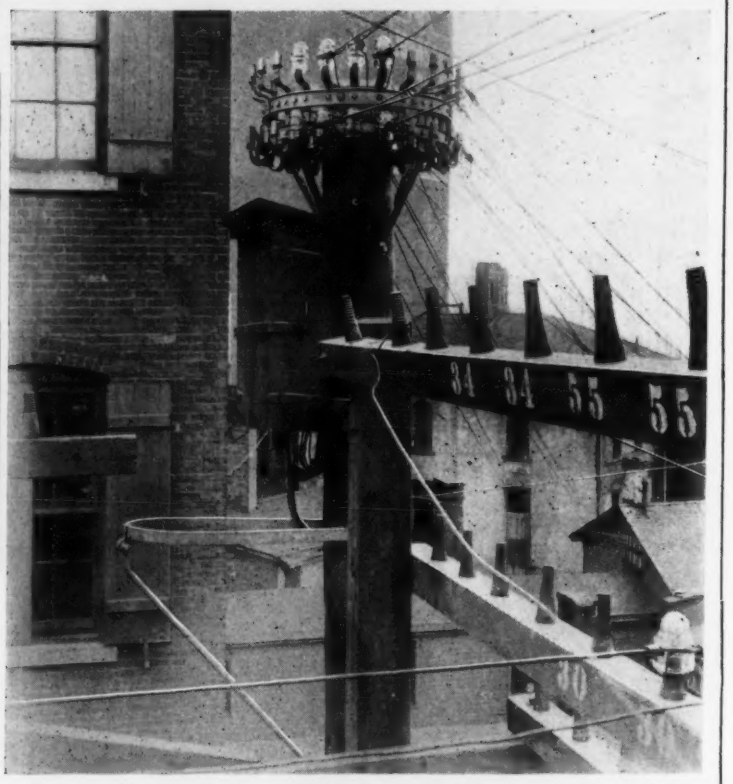


FIG. 7.—DISTRIBUTING POLE.

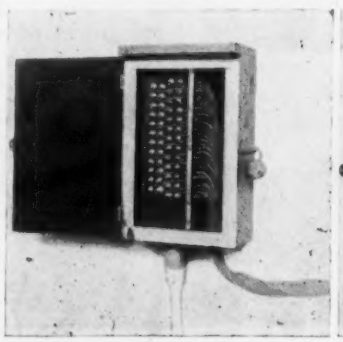


FIG. 10.—BASEMENT BOX WITH CABLE CONNECTIONS.

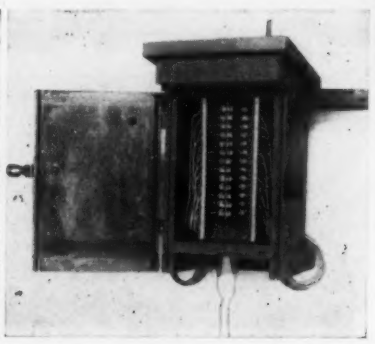
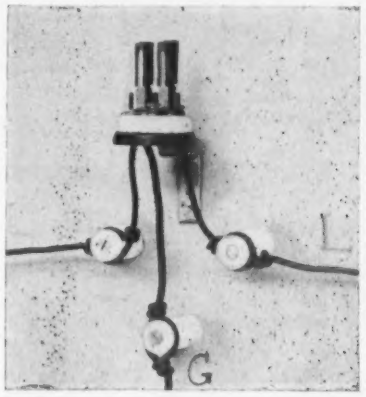


FIG. 8.—POLE BOX WITH LIGHTNING ARRESTERS.



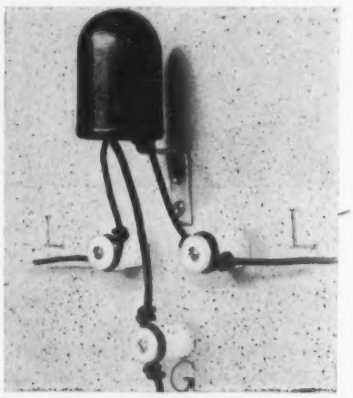


FIG. 11 AND 12.—INDIVIDUAL LIGHTNING ARRESTER. UNCOVERED AND COVERED.

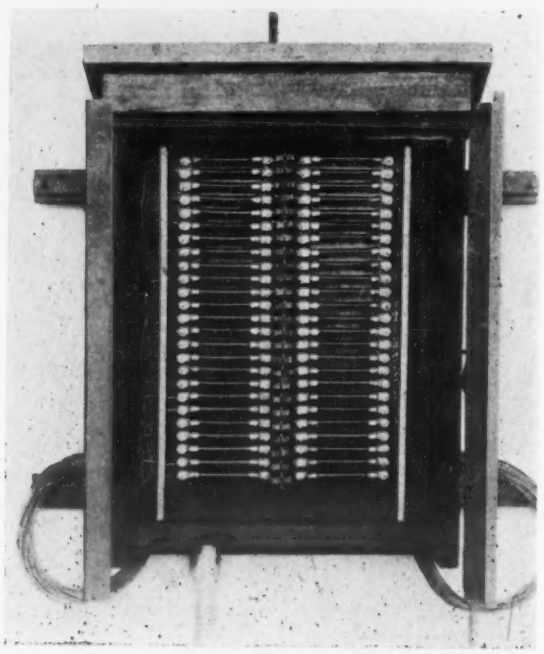


FIG. 9.—POLE BOX WITH LIGHTNING ARRESTERS AND FUSES.

the center of each group drives the alternating-current ringing generators at a speed of 1,050 r.p.m., and is a 1-hp, four-pole Holtzer-Cabot direct-current motor.

The ringing buttons for the four party lines are connected with each of the small ringing alternators. Party No. 1 bell receives current from alternator No. 1, which is a bipolar machine supplying a current of 1.5 amp at a pressure of 100 volts and a frequency of 17.5 cycles, while the bell of party No. 2 receives its current from ringing alternator No. 2, supplying a current of 1.5 amp at a pressure of 100 volts and a frequency of 35 cycles. In the same manner the party No. 3 bell is rung by alternator No. 3, having the same voltage and current, but supplied with six poles, while the former, No. 2, only had four poles, the periodicity being in this case 52.5 cycles instead of 35 cycles. Similarly alternator No. 4 rings the party No. 4 line bells, having the same voltage and current, but a current of 70 periods, the number of poles of this machine being eight. Each bell on the line is thus adjusted to ring only with the number of alternations which corresponds to the proper alternator and button of the operator. These buttons are colored red, green, black and blue, and the selective ringing is thus easily manipulated by the operators at the main telephone switchboard.

The telephone switchboard of the Frontier Telephone Company is of the latest improved type, as will be noted by the accompanying view, Fig. 3, which shows a large part of the 23 sections already installed. The complete switchboard on both floors will consist of 56 sections with three operators for each section. The board is finished in mahogany and each section is 5 ft. 7½ in. long and 7 ft. high. The total capacity of the board when completed will be 18,000 lines, which, including the four-party lines, will accommodate 36,000 subscribers. This board is very compact, and is already equipped for 8,000 lines, while it is stated that this exchange starts out with as large a list of patrons as that of any company installing a completely new plant.

The general working of this switchboard and exchange is similar to other modern common battery systems. A subscriber taking his receiver from the hook of his instrument operates a line relay in the terminal room seen in the accompanying Fig. 5 at the right. This line relay in turn lights a miniature lamp in front of the operator at the switchboard proper. She inserts an answering plug in the jack associated with this lamp plug, which in turn operates another relay called a cut-off relay, which extinguishes the line lamp. At the same time it cuts the operator's or switchboard line on to the subscriber's line. The room for practice work for the operators is seen in Fig. 6, and it is here that the necessary instruction is given new employees. After the lines are connected the operator asks the number, and, having received it from the subscriber, connects this subscriber by inserting another plug called the calling plug to the desired number. The switchboard cords are equipped with a double supervisory system whereby an operator by means of the supervisory lamps associated with each plug can tell whether a subscriber does not answer, or is talking over the line, or is through talking. The switchboard is also supplied with the usual busy test, whereby an operator before making a subscriber's connection first touches one side of the line wanted with the tip of her plug.

The accompanying illustration, Fig. 7, shows a distributing pole with ring top and pole box, while Figs. 8, 9 and 10 show 13-pair and 25-pair pole boxes with fuses and lightning arresters, as well as a 25-pair basement box with cable connections. The Figs., 11 and 12, show the latest type of individual lightning arresters, represented open and closed as installed outside of the subscriber's window or entrance.

The tariff rates of the Frontier Telephone Company, of Buffalo, are as follows, which are for unlimited service: For business telephones on direct lines the charge is $48 per year, while for private service on direct lines the charge is $36. On the party lines, the rates for the business purposes varied according to the number of subscribers upon the same line. The two party business telephones cost $40 per year, three party $32 and four party $24. In a similar manner the charges are arranged for residence service at $24, $20 and $15 per year for 2, 3 or 4 party lines respectively.

The total number of subscribers already under contract is said to be more than 10,000, and several thousand are already connected and are getting excellent service. As soon as the party-line instruments arrive several thousand more will be connected up. These instruments are expected at an early date.

The Testing of Recording Wattmeters on the Consumer's Premises by Means of a Specially Constructed Portable Test Meter.

By W. J. MOWBRAY.

WHEN the various electric lighting companies of this country first considered the advisability of making the change from chemical to motor meters, the motor meter was generally considered to be an instrument which would continue to record accurately for a long period of time with very little attention. The contrary, however, proved to be the case, and those companies who rather suddenly made the above change found an amount of trouble on their hands, a large portion of which they never bargained for. It is true that these new motor meters gave good service for a short period, but they soon became slow, especially on light loads, to an extent which considerably decreased the company's revenue.

The problem, "How shall we keep our meters recording accurately?" then became a very important one, and different companies set about the solution in different ways. Some periodically replaced all consumer's meters with others which had just been calibrated in the station test room. However, the accuracy of these meters immediately after installation in the consumer's premises was often found to differ very materially from their calibrated accuracy in the station, due, no doubt, to the fact that they had *not* been calibrated under actual working conditions and that they were sometimes subjected to severe shocks and jars in transportation. Other companies took the stand that all meters should be tested under actual working conditions, that is, on the consumer's premises, and this, we think, is now generally conceded to be the better practice. None of the then existing methods of testing on the consumer's premises, however, possessed both the elements of quickness and accuracy, the ammeter and voltmeter method being accurate, but at the same time very slow, and, therefore, correspondingly expensive, while the system of testing the consumer's meter with another similar meter was inaccurate on light loads and was cumbersome in that it necessitated the daily checking and transportation of approximately as many testmeters as there were different capacities of consumer's meters to be tested.

Keeping in mind the four elements essential to the success of a system of this kind, namely, accuracy, quickness, low first cost and cheapness of maintenance, the writer, foreman of the Meter-Testing Department of the Brooklyn Edison Company, has developed the system herein described, a short outline of which was read before the 1902 convention of the Association of Edison Illuminating Companies.

This system uses as a portable test meter or so-called standard, a Thomson recording wattmeter with the recording mechanism omitted and having several special features, some of which are designed to secure quickness in connecting and manipulating, and others to eliminate the errors inherent to the ordinary meter of the above type when used as a test instrument. The principal causes of these errors are as follows:

(1) Changes in friction and vibration, especially when testmeter is running on light load. Changes in commutator friction may change the accuracy on one-tenth load as much as 10 per cent. in one day, and on a similar load any heavy vibration such as that caused by a passing truck or trolley car may change the accuracy for the time being to a very serious extent.

(2) Using the testmeter before the temperature and resistance of the potential circuit have become normal. The testmeter runs fast when the potential circuit is cold, due to having been disconnected for some time.

(3) Connecting the testmeter on the wrong polarity. This would make an error, especially on light loads, due to the projected field from the drag magnets.

(4) Heat radiated by the fields of the testmeter when carrying a heavy load for a considerable length of time. This heat increases the resistance of the armature and causes the testmeter to run slow to a slight extent.

Of the above errors, Nos. 1 and 2 are by far the most serious.

The principal features of the standard meter are as follows:

A double field winding is the principal and fundamental feature of the instrument, and is designed to render error No. 1, due to changes in friction and vibration, so small as to be negligible. This double winding gives three or four current scales. The advantage of a testmeter or standard having three current scales is comparable

with that obtained by using a three-scale millivoltmeter and shunt instead of a single-scale ammeter. However, the multiplicity of scales is more important in the case of the standard meter, due to the fact that while the accuracy of the Thomson meter on full load is good, its acuracy on light load is much more erratic than that of an ammeter. By never using the standard on light load, that is, by always putting the load to be measured on a suitable scale (or field), the test instrument is always run at a sufficiently high torque to minimize the errors due to changes in friction and vibration.

In a 10-amp standard, which is initially a regular 10-amp, 115-volt, 2-wire Thomson meter, an additional field coil of 1 amp carrying capacity is wound around each of the regular 10-amp fields. The number of turns in each of these new windings is such that when 1 amp flows in it the moving parts of the standard will rotate at exactly the same speed as when a current of 10 amp flows in one of the regular 10-amp fields. In order to convey a clear mental picture of this arrangement, we will remind the reader that in the ordinary Thomson meter the armature revolves between a right and a left-hand field coil. This portion of the standard looks exactly similar, the only difference being that both the right and left-hand fields of the standard are composite, each consisting of a 10-amp inside, and a 1-amp outside winding.

The wire used for this 1-amp winding is No. 20 B. & S., single cotton-covered, and the number of turns wound around the outside of each 10-amp field may vary between the limits of 325 and 330, disposed in 13 layers of approximately 25 turns each. An exact total number of turns is not necessary, for the reason that widening or narrowing the space between the right and left-hand composite fields changes the effective flux of the 10-amp winding to a much greater extent than that of the 1-amp. Such being the case, the right and left-hand fields are brought slightly closer together if the standard runs slower on 10 than on 1 amp, and vice-versa. The two halves of the 1-amp winding are connected to a small specially constructed switch by means of which they can be thrown either in series or in multiple. When in multiple, their capacity is, of course, increased to 2 amp. This construction gives three current scales which are rated as follows:

1 ampere scale = 1 ampere fields in series.
2 ampere scale = 1 ampere fields in multiple.
10 ampere scale = 10 ampere fields in series.

It is a generally known fact that the accuracy of the Thomson meter is practically independent of ordinary changes in friction and vibration on loads exceeding one-half its rated capacity, and that it will carry 25 per cent. overload for a considerable time without introducing serious heat errors. In other words, that portion of its accuracy curve from 50 to 125 per cent. of its rated capacity, is very nearly a straight line. In view of this fact, it can be seen that the ranges through which the above-mentioned current scales can be used with accuracy are as follows:

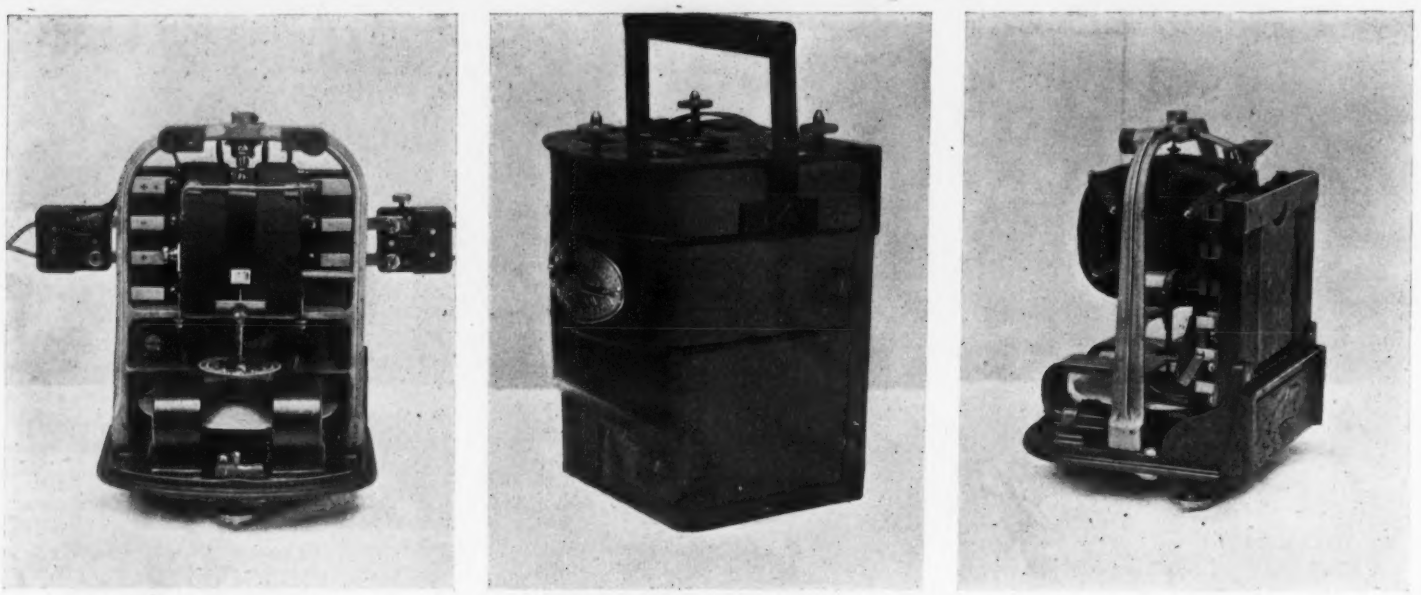
1 ampere scale is accurate from .5 to 1.25 amperes.
2 ampere scale is accurate from 1.0 to 2.5 amperes.
10 ampere scale is accurate from 5.0 to 12.5 amperes.

The 10-amp standard, the various scales and ranges of which have just been enumerated, is used to test all consumer's meters from 3 to 25-amp capacity. The full load of the meter to be tested is taken at from 50 to 100 per cent., and the light load at approximately 10 per cent. of its rated capacity. The current scales of the 10-amp standard are used as follows:

1 amp. scale is used for light load of 3 to 15 amp. meters.
2 amp. scale is used for light load of 15 to 25 amp. meters.
2 amp. scale is used for full load of 3 to 3½ amp. meters.
10 amp. scale is used for full load of 5 to 25 amp. meters.

Larger meters, up to 300-amp capacity, are tested with a 75-amp standard, which is similar in its general principles to the 10-amp, with the addition that both its 7½ and 75-amp windings can each be connected either in series or multiple, thus giving the instrument 4 scales, namely, 7½, 15, 75 and 150-amp.

Error No. 2, caused by using the standard before the temperature, and consequently the resistance, of the potential circuit has become normal, would ordinarily be avoided by connecting the potential circuit on its normal voltage and allowing it to remain thus for at least 15 minutes. This would occupy too much time, especially when it is remembered that the object of the system is to get through with the test as quickly as is compatible with accuracy. This heating is best accomplished by connecting the potential circuit of the standard to a voltage double that for which it is rated for a time of 1½ minutes. Where this double voltage is not to be had, the normal voltage is applied to the two halves of the potential circuit in multiple, for a time of 1½ minutes as before. After heating by either of these methods, the standard is given its normal voltage and connections and is then ready for use.



FIGS. 1, 2 AND 3.—PORTABLE TEST METER.

In addition to the three current scales previously described, there are two potential scales, namely, 115 and 230 volts. The 115-volt potential circuit consists of the armature in series with an ordinary adjustable shunt, the armature being the standard article for a 10-115-2-meter, and the shunt having 1,200 turns and approximately 450 ohms resistance. The 230-volt potential circuit consists of the armature, shunt and a resistance card of resistance at normal working temperature equal to that of the armature plus the shunt in the same condition. This card is wound with tinned iron and German silver wire in the proportion of 76½ per cent. of the former to 23½ per cent. of the latter. This is the proportion used regularly by meter manufacturers, the object being to get a potential circuit having a temperature coefficient equal to that of the metal of which the disc is composed.

The standard is intended to be used principally on direct-current, but can also be used with very slight error on non-inductive, alternating current, that is, with a lamp bank or water resistance load. It must not, however, be used on inductive alternating-current circuits, except it is properly compensated therefor, as the above-described potential circuits are rather inductive.

With the exception of the double-field winding, the sight method of determining the percentage accuracy of the consumer's meter is the most important feature of the instrument. Without the double fields the standard would be so inaccurate on light loads as to prohibit its use, and without the sight method of determining the percentage accuracy it would be very little quicker than the ammeter

and voltmeter. The principal saving of time when using the standard is due to the fact that the speed of the consumer's meter is compared directly with that of the standard, the per cent. fast or slow being determined immediately within ⅕ of 1 per cent., without having recourse to either slide-rule or stop watch.

With the ammeter and voltmeter system, the comparison is between the speed of the consumer's meter and the volt-amp, necessitating the laborious slide-rule process of multiplying the *volts* by the *amperes* to obtain *watts* (on direct current), reducing the *speed* of the consumer's meter to *meter watts*, and dividing the latter by the former to get the per cent. accuracy. The sight method, therefore, by rendering unnecessary the use of the slide-rule and stop-watch, effects a great saving in time. We will here state that the standard meter system requires a team of two men—a tester and a helper—and that, in our opinion, all important work such as determining the per cent. accuracy, repairing and adjusting the consumer's meter, etc., should be the duty of the more experienced and responsible man, namely the tester. The tester is, therefore, stationed at the consumer's meter and the helper at the standard. The per cent. accuracy of the consumer's meter is determined as follows:

The tester uses a circular scale, consisting of a piece of sheet brass on which is stuck a circular blue print of approximately two and one-half inches in diameter. The circumference of this blue print is divided by heavy lines into ten large divisions numbered from 1 to 10, and each of these large divisions is subdivided by fine lines into ten small divisions, thus making a total of 100 small divisions around the entire circumference of the circle. This scale is temporarily attached to the consumer's meter, just above the magnets, in a horizontal position, and adjusts itself so that the shaft of the meter passes exactly through its center and makes a right angle with its surface. A light-weight pointer is attached to the shaft of the meter rather close to th surface of the circular scale, over the entire 100 divisions of which this pointer passes in one complete revolution of the meter armature.

The meter is first tested on light load, and should, if accurate, make one complete revolution in exactly the same time in which the standard makes a certain definite number found by reference to a table of revolutions. The *helper* observes a white mark on the disc of the standard, and in a short and sharp tone of voice gives the word "On" at the beginning, and the word "Off" at the end of this allotted number of revolutions of the standard. At the words "On" and "Off" the *tester* notes carefully the position of the pointer on the circular scale which is attached to the consumer's meter, the per cent. accuracy being the number of small divisions passed over by the pointer between these two words.

For example, if the pointer is observed, from the word on to the word off, to pass over .85 of a revolution or 85 small divisions, the accuracy of the meter is 85 per cent. The same thing may be expressed in a different manner by saying that the number of small divisions which the pointer needs to complete one revolution, is the per cent. slow, and the number by which it exceeds one revolution is the per cent. fast.

The same method is used on full load with the exception that in the period of time between the words "On" and "Off" the consumer's meter, if accurate, makes ten complete revolutions instead of one. It will be remembered that besides being divided into 100 small divisions, the circular scale is also divided into ten large divisions numbered from 1 to 10. It is evident, then, that in ten complete revolutions the pointer passes over 100 of these large divisions, each of which have, therefore, a value of 1 per cent., and the per cent. accuracy is read directly same as on light load. For example, if from the word on to the word off the pointer is observed to make 9.5 revolutions, it has passed over 95 large scale divisions and the accuracy is 95 per cent. The number of large divisions which the pointer needs to complete ten revolutions is the per cent. slow, and the number by which it exceeds ten revolutions the per cent. fast.

When the number of revolutions which the consumer's meter should make between the words "On" and "Off" is other than 10, the formula for determining the accuracy is as follows: Accuracy equals the actual revolutions and fractions thereof made by the consumer's meter, divided by the allotted revolutions of the consumer's meter. For example, if the actual number of meter revolutions is observed to be 4.8, and the allotted number is 5, the accuracy equals 4.8 divided by 5, or 95 per cent. It will be seen that a slide rule is not necessary for an operation of this kind, as the divisor is never a fractional number.

Another circular scale and pointer similar to that described is permanently attached in a similar location to the standard. This makes it possible to station the tester at the standard and the helper at the consumer's meter, if this disposition of the men is considered desirable. It is principally useful, however, in cases where the meter to be tested is not of the regular pattern, thereby making it difficult to attach the circular scale. .The formula in this case is: Accuracy of consumer's meter equals allotted revolutions of standard, divided by the actual revolutions and fractions thereof of the standard. The words "On" and "Off" are in this case given by the helper from observation of a white mark on the disc of the consumer's meter. This method requires the use of a slide-rule, as the fractional number of revolutions is the divisor. It also has the disadvantage of allowing the less experienced man to make the adjustments on the consumer's meter. We would, therefore, recommend the method first described, namely, that of attaching the scale and pointer to the consumer's meter, except in special cases where it is found impossible to do so.

It will be remembered that the essential elements of a successful meter-testing system were stated to be four in number, namely, accuracy, quickness, low first cost and cheapness of maintenance. In the foregoing portion of the description of the standard it is shown how accuracy and quickness are secured—the first principally by the double-field, 3-scale, scheme, and the second principally by the sight method of determining the percentage. The third and fourth essential elements, namely, low first cost, and cheapness of maintenance, will now be taken up.

The cost of the standard, buying the regular meter parts from the manufacturer, and making the special parts in the company's machine or meter shop, does not exceed $40, as against $170 for a first-class shunt ammeter and voltmeter.

The parts of the standard are mostly regular meter repair parts, such as are kept in stock by all central stations. The company's meter repair man can make all necessary repairs, while each tester can calibrate his own instrument. This is a very decided advantage when the expense and delay of having indicating instruments repaired and calibrated by the manufacturer is taken into consideration.

This system has been in use by the Brooklyn Edison Company from January 1, 1902, up to the present date, with the following results:

Volt-ammeter checks have shown the system to possess a high degree of commercial accuracy. It has increased the number of meters tested in service per team per week 65 per cent., as compared with our former records with the ammeter and voltmter. Our average, using the standard, for the last eight months of 1902, and January and February of 1903, was 45.1 per team per week, or 7.52 per day, and the maximum number tested by one team in one day was 14. The above average of 7.52 per team per day was obtained notwithstanding the fact that it includes large meters up to 300 amp capacity, special tests for investigation of consumer's complaints (19.5 per cent. of the total number tested), and that our territory is very extended.

The cost of maintenance has been very slight, and in one case where a standard was allowed to fall and was very seriously damaged, we succeeded in repairing it in one day.

System of Electric Control for New York Subway.

THE system of electric control which has been adopted for use on the New York Subway trains is similar to that employed on the Manhattan Elevated trains, and will be supplied by the General Electric Company, which also furnished the Manhattan electric control equipment. Some changes, however, have been introduced, the most notable of which is an attachment to the master controller which enables automatic acceleration to be secured without interference with the manual operation of the controller.

The master controller has twelve notches instead of ten, as with the Manhattan controller. The operating cylinder instead of being directly attached to the control handle is moved by the handle through the medium of a spring. To secure automatic accelaration the motorman moves the operating handle notch by notch, the operating cylinder following, or he can throw the handle to either full series or full parallel position. In either case the spring causes the operating cylinder to follow the movement of the handle until it reaches a position corresponding to that of the operating handle. To prevent the operating cylinder from moving too rapidly its speed

is regulated by a limiting device, and the rate of current input is regulated by a current relay in series with the motor circuit. This

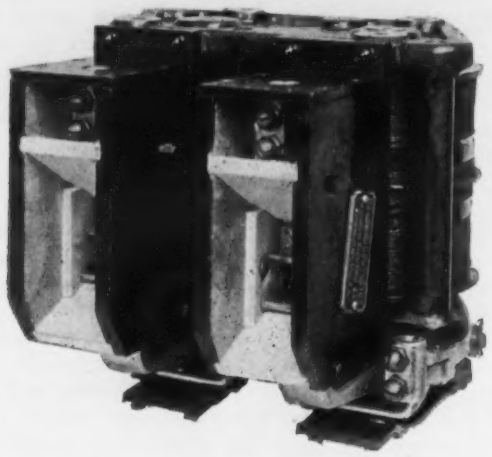


FIG. 1.—NEW FORM OF CONTACTOR.

closes a local circuit, locking the master controller cylinder against movement until the acceleration current has fallen sufficiently to release the master control cylinder for the next notch. In other words, the motorman in notching up slowly controls the train in exaactly the same manner as the ordinary manually-operated master controller. The automatic feature comes into operation only when the rate at which the operating handle is turned on would allow more than the desired amount of current to pass through the motors if it was limited. In ordinary practice, however, the motorman throws the handle to the full parallel position, and the controller cylinder follows up, notch by notch, as fast as the motor current will permit.

An improvement has also been made in the form of contactor. A view of a pair of the contactors to be used on the subway cars is shown in one of the accompanying cuts. As will be noticed, two contactors are mounted on the same base, instead of having them entirely separate, as in the Manhattan equipment. This plan of grouping contactors has been followed where two or more are of the same potential, and in the subway equipment there will be several groups of two and three contactors each. This saves room and also avoids the necessity of much of the interconnection of the contactors by heavy wires.

An improved form of contactor blow-out has also been adopted. It is considered by the manufacturers more efficient than that used on the Manhattan equipment, and by it a considerable reduction in weight has been secured with a greater current carrying capacity.

A diagram of the connections which will be used in the control system adopted is shown in Fig. 2. By following out the control circuits on first notch, it will be seen that the coils of contactors 6, 7, 9 and 15 are energized in the order given. This allows the main current from the motors to flow first through contactor No. 7, then through contactor No. 6, resistances *R*-1 to *R*-8, motor No. 1 and contactor No. 15; then through contactor No. 9 and resistances *R*-7 to *R*-12, and then through motor No. 2 to ground. On the second series notch, contactors No. 5 and No. 10 are picked up, each cutting out a portion of the resistance. The remaining resistance contactors pick up until all of the resistance is cut out, and the full series position is reached. The connections on the first parallel notch are such that the current for No. 1 motor passes through contactor No. 7 and No. 6, and through resistance *R*-1 to 8. The current for No. 2 motor in parallel working passes through contactors No. 8 and No. 9 and resistances *R*-7 to *R*-12.

It will be seen from this statement that the connections differ from

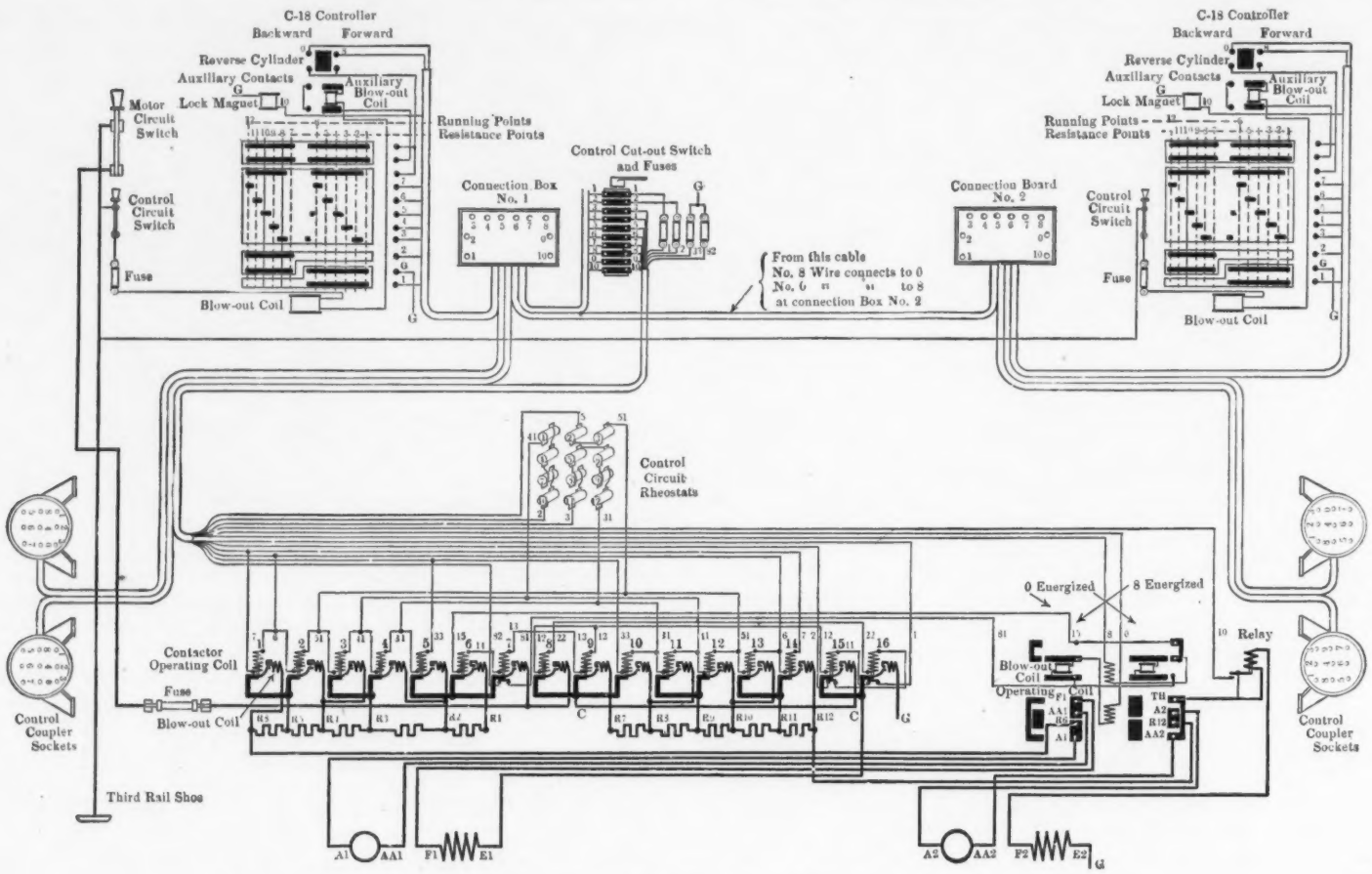


FIG. 2.—DIAGRAM OF CONNECTIONS OF CONTROL SYSTEM FOR NEW YORK SUBWAY TRAINS.

those of the former type M control in two important particulars. First, the resistances are divided into two groups, and each group is always used with the same motor and only for that motor. The other point of difference lies in the fact that each resistance contactor short-circuits one section of the resistance only instead of controlling in some cases more than one. It follows from this that each contactor carries the current of only one motor. This arrangement allows the resistance grids to be made of larger cross-section. At the same time the number of contactors required is not materially increased, owing to the fact that with the former method, in some cases, two contactors had to be used in parallel when working with heavy current. By the arrangement described the actual number of contactors is increased only by two, viz., from 14 to 16.

The controller system adopted is made under the Sprague and General Electric patents.

The Heyland Induction Motor.

(Concluded.)

BY BOY DE LA TOUR.

WE must now ascertain by what means it will be possible to preserve both the magnitude and direction of the magnetic flux, $A\,C$, while, at the same time, utilizing an e.m.f., E_2, which will always be in phase with that of the source supplying current to the motor.

We will show that the desired result may be obtained by simply displacing all three sets of brushes on the commutator in a direction opposite to that of the revolving magnetic field.

This displacement of the brushes, which involves that of the different branches of the winding, having taken place in a direction opposed to that of the rotation of the magnetic field, the e.m.f., e_2, induced by this revolving magnetic field in each of the branches will, therefore, advance by an angle corresponding to that which might have been produced before the brushes were moved (Fig. 3).

This e.m.f., e_2, retains the same magnitude as in Fig. 2.

Let us suppose the displacement of the brushes to have been such that the e.m.f., $A\,F$, which should be applied to the brushes in order to preserve the current i_2'' at its preceding value, falls along the line $O\,A$; that is to say, in phase with the e.m.f. of the source of current supply.

It is easy to understand that this displacement of the brushes has in no way modified the magnitude and phase of the fictitious magnetic flux of the second winding.

In fact, when the brushes were moved backward in the revolving magnetic field, thereby making the phase of the e.m.f. applied to these brushes lead forward by an angle equal to the displacement of the brushes, a forward lead of the same amount with respect to the brushes was also, at the same time, given to the induced e.m.f. e_2, to the current i_2'', and, consequently, to the fictitious magnetic flux produced by that current.

It follows that the displacement of the brushes has not changed the instantaneous position of this fictitious magnetic flux with respect to the others.

This fictitious magnetic flux, therefore, remains in the direction $A\,C$, although the current is in the direction $A\,G$ (Fig. 3).

The diagram shows that the potential difference, $A\,F$, at the brushes has a lead-in phase with respect to the current i_2'' produced by the external source of rotor current.

We must not conclude, however, that this displacement of the

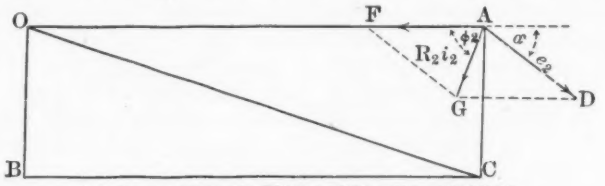


FIG. 3.—EFFECT OF DISPLACING THE BRUSHES.

brushes is capable of materially lowering the power factor of the magnetic field which, in all the diagrams given, has been assumed equal to unity.

It is apparent that the current i_2'' must always be smaller than the current i_2' when the motor is carrying a load.

On the other hand, the power $e_2 i_2'$ wasted by resistance heating (Joulean effect) in the ordinary winding itself amounts to only two or three per cent. of the power which is applied to the stator.

We may conclude, therefore, that the power $e_2 i_2''$ taken from the external source of current, and sent through the brushes into each of the branches of the stator, is very small, since it itself remains much below $e_2 i_2$, and, as a general rule, does not attain one per cent. of the watted power supplied to the primary winding.

It follows that the definite value of $cos\ \phi$ for any machine will differ only by a negligible quantity from the value of the power factor for the stator circuits alone. This is all the more exact inasmuch as a considerable amount of the current sent into the rotor through the brushes is not wattless.

Let us note again that the resultant effect of the currents $i_2' i_2''$ is given, both in magnitude and in phase, by the vector $O\,C$.

The potential difference, $A\,E$, which must be applied at the brushes, is generally very low compared to that applied at the motor terminals. This potential difference may be obtained either by means of a small auxiliary transformer connected in parallel across the motor terminals, or by means of a winding of a few turns placed on the stator core.

When the torque diminishes, the slip decreases. The area of the triangle $O\,A\,C$ diminishes in the same proportion as the torque. The resultant magnetic flux $O\,B$, on the contrary, does not vary, since it must induce a constant e.m.f. in the stator.

If, for this new load, we wish to preserve a power factor equal to unity, the right line, $A\,C$, will have to retain its magnitude and direction. Since i_2'' cannot change, and since e_2 depends on the slip, the potential difference which must be now applied at the brushes will not only be smaller than in Fig. 2, but will also have a greater inclination with respect to the right line, $O\,A$.

It will be necessary, therefore, in order to neutralize the phase difference in the primary, to again displace the brushes and to diminish the amount of the potential difference applied to the brushes. The latter adjustment may be obtained by means of variable resistances interposed in the leads conveying current to the brush connections.

If, on the other hand, the load were increased, these operations would naturally be reversed.

When the power factor is equal to unity, the stator current has, very nearly, a ratio which is substantially proportional to the torque.

It might perhaps be possible, therefore, in certain cases to avoid

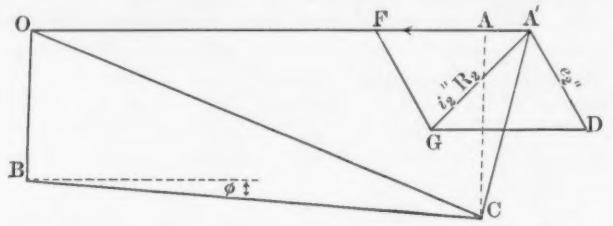


FIG. 4.—EFFECT OF DISPLACING THE BRUSHES.

the necessity of adjusting the potential difference applied at the brushes by making use of a transformer whose primary is connected in series with the stator winding.

It is interesting to ascertain what would happen, if, without changing the potential difference applied to them, the brushes are displaced more than would be necessary to give $cos\ \phi = 1$, in the primary winding.

The right line, $O\,B$ (Fig. 4) remains the same as it would be in Fig. 3.

The distance $O\,A$ will not vary; and, since the torque remains constant, the point C will be on a straight line passing through A and parallel to $O\,B$.

Since, by hypothesis, the brushes have been displaced more than was necessary, the vector $A'D$, $A'G$, and $A'C$ will have a greater inclination with respect to their right line $O\,A$ than they have for the case illustrated in Fig. 3.

In order to change $O\,A$ to $O\,A'$, the slip must increase. This circumstance will increase the e.m.f. e_2, as well as the current i_2''.

But since the fictitious magnetic flux $A'C$ is produced by this current i_2'', its value will, therefore, be greater than was the case in Fig. 3.

The inclination of the vector $B\,C$ resulting from the length of $A'C$ shows that the power factor will become negative in the stator winding; that is to say, that the primary current through the stator will now lead the e.m.f. applied at the motor terminals

We might expect this result, which could also be attained by retaining the same position of the brushes as in Fig. 3, and simply increasing the value $A\,F$ of the potential difference applied to these brushes.

These points having been established, we will now show how easily the diagram may be corrected for magnetic leakage and for the resistance of the stator winding.

In designing an induction motor, we generally assume, at the beginning, the resultant magnetic density in the air-gap and the peripheral velocity of the rotor.

The latter seldom exceeds 25 metres (82 ft.) per second; the resultant magnetic density varies according to the size and character of motor, between 2,500 and 3,500 gausses.

Knowing the output and speed, the electromagnetic (tangential) effort (magnetic pull) at the periphery of the stator may be determined. We then calculate the reaction of the secondary winding, or, in other words, the value of the fictitious magnetic flux above

mentioned, without paying attention, for the moment, to the Heyland principle.

It will then be possible to indicate, in Fig. 5, the value OB of the resultant flux, as well as the value OA of the fictitious magnetic flux, $V_2\Phi_2$, of the rotor, and to also determine the vector AB, which represents that portion, Φ_1, of the fictitious magnetic flux of the stator which penetrates the secondary core.

If the torque is not to be varied when the brushes are applied to the commutator, the point C must fall on a right line, AC, parallel to OB.

Owing to magnetic leakage, this point C will fall beyond the point C', obtained by the intersection of the right line, AC, with the right line, BC', parallel to OA.

Let us select the position of this point C. The vector AC will represent the fictitious magnetic flux produced by the current sent from an external source into the secondary or stator winding by means of the brushes.

The resultant fictitious magnetic flux of the rotor will be represented in magnitude and direction by OC.

In order to obtain equilibrium, BC must be equal to that portion of the primary fictitious magnetic flux which passes through the air-gap.

If now we plot, along BC prolonged, the distance BH, equal to the primary leakage—that is to say, equal to Φ_1 $(V_1 - 1)$—and if we plot, along OC, the distance HK, representing the secondary Φ_2 $(V_2 - 1)$, then the vector, OK, will indicate, both in magnitude and in direction, the resultant magnetic flux in the stator.

This resultant flux induces an e.m.f., OM, which lags 90° behind OK, and which differs but slightly from the potential difference, E_1, at the motor terminals. If it be required that the power factor

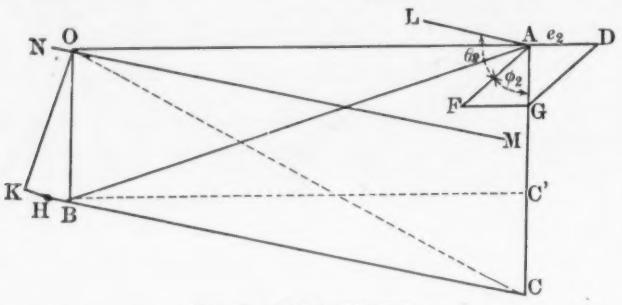


FIG. 5.—FLUX VALUES.

shall be equal to unity, this induced e.m.f., OM, must be parallel to BC, which represents the stator current.

If this were not the case, it would be necessary to reconstruct the diagram, starting from a point C, situated at some other point along the line AC.

When once this condition is fulfilled, the ohmic drop, R_1i_1, is to be plotted on ON prolonged, being indicated by the distance OM.

The difference of potential at the terminals will then be represented by the length NM.

If we also draw AD equal to e_2, and $HG = R_2i_2''$, the difference of potential which must be applied to the motor brushes will be represented by the distance AF. The right line, AL, being drawn parallel to NM, the angle, LAF, will indicate the extent to which the brushes must be displaced.

Before closing this study, we may observe that, if the stators were constructed as indicated hereinabove, serious sparking would inevitably result at the brushes.

These sparks are due to the high self-induction of the portions of the stator-winding which are short-circuited at the brushes.

As the number of conductors per pole is always somewhat limited, a variation of the magnetic flux will occur when one of these conductors is cut out of circuit by the short-circuiting action of the brushes.

The effect of this variation is to retard the reversal of current in the portions of the winding which are at the commutation point, and to occasion an excessive potential difference between the collector and the trailing end of the brush.

It is this excessive difference of potential which is the direct cause of the sparking. To avoid this undesirable sparking, the commutator segments are shunted, i. e., partly circuited, by means of resistances.

It is evident that the shunting resistances not only complicate the construction of the motor, but also absorb some energy.

It would probably be difficult to predetermine by calculation the proper amount of resistance to be interposed between any two consecutive commutator segments. The resistance should be determined by experiment after the machine has been finished. It would seem that by increasing the number of active conductors per pole, as well as the number of commutator segments, the importance of these resistances, and of the currents which pass through them, might be materially reduced. These resistances, thus arranged, form a circuit which has much resemblance to the short-circuiting ring of the squirrel-cage winding, and practically the commutator segments and shunting resistances would doubtless take the form of such a ring, having a definite resistance.

Looking at the matter closely, we observe that the currents in these resistances modify the currents which would otherwise pass through the rotor winding.

We can, in the diagram, retain the action of these first currents, and superpose the magnetic effect of those which circulate through the winding and the commutator shunting resistances.

These currents must be in phase with the e.m.f. which produces them, and, consequently, they must lag 90° with the resultant field OB in the air-gap. They will, therefore, produce a fictitious magnetic flux, having the direction OA, and they will tend at the same time to increase the torque.

It will, therefore, be possible, thanks to their presence, to diminish slightly the secondary current, i_2', in order that, finally, the length of the vector, OA, may retain its original value. It is seen, therefore, that the currents passing through the shunting resistance of the commutator are not useless. The ohmic drop which they produce in the conductors is compensated by a reduction in the amount of the current i_2'.

Let us note further that since the slip at the instant of starting is easily thirty times greater than when running at full load, the currents in the commutator shunting resistances will increase in the same ratio.

It will, therefore, be necessary to make these resistances of large current-carrying capacity, in order to prevent their burning out when starting the motor.

To sum up, the arrangement devised by Mr. Heyland enables a power factor equal to unity to be obtained at all loads. This property of the Heyland motor type, which is already an advantage in itself, would seem to be further enhanced by the possibility of its enabling motors to be designed with larger air-gaps than those of present motors.

But the constancy of the power factor under changes of load can only be obtained by regulating, in some way, the potential difference applied to the brushes, or by the simultaneous use of both means of regulation.

The ordinary induction motors, as a substitute for which the Heyland system is proposed, give at full load, when well designed, a power factor equal to 0.9, which decreases slightly with the load, and is still as high as about 0.87 when the torque falls down to about ¾ of its normal value.

In order to raise the power factor from 0.9 to 1.0, it is necessary, in the Heyland motor, to provide the rotor with the commutator and an outfit of brushes; it is also necessary that all the segments of this commutator be shunted by resistances mounted on the rotor. It is also necessary, except in a few particular cases, to transform the primary e.m.f., in order to obtain the necessary potential difference to be applied to the brushes; and this potential difference must be regulated by hand within rather wide limits.

The principal merit of induction motors consists, without doubt, in their great simplicity of construction, which enables them to operate without requiring, so to speak, any attention or repairs.

In order to slightly improve the power factor, and to raise it from 0.9 to 1.0, a motor even more complicated than a direct-current motor has been devised, which, owing to the losses in the commutator shunting resistances, has an efficiency materially lower than that of the present induction motors; and, besides, it is by no means certain that in practice, when once sold and put in operation, the new machines will remain constantly regulated for a power factor equal to unity.

Under such conditions, what are the prospects of success for this invention? The future will tell.

The author prefers to abstain from answering this question, first, in order to avoid the appearance of being too pessimistic, and, second, because he has a firm belief that others will not fail to discover new improvements, perhaps new inventions even, which will eventually make the induction motor the ideal machine.

Electric Railways in Sweden.

BY ARVID WESTERBERG.

IN a communication to your columns (January 24, 1903) the writer referred to a report submitted by Mr. R. Dahlander to the Royal Swedish Railroad Administration on the practicability of substituting electric for steam power in the operation of the government railroads. Below a short abstract of this report is given:

Since the traffic on the Swedish railroads is relatively small, a system with low tension would be too expensive, and consequently the use of direct current is impossible. A three-phase system would be too complicated, because of the necessary two or three-contact lines, which would cause trouble, especially in tunnels and at the stations. Therefore, a high-tension, single-phase system is the only feasible one.

Three of the existing systems of this kind, none of which is in practical use yet, were then taken into consideration, viz.: the Ward Leonard system adopted by the Oerlikon Company, Zürich; the Arnold system and the Lamme-Westinghouse system.

The natural power sources of Sweden are very abundant. Based on the report of Mr. J. Gustaf Richert on the waterfalls and of Mr. E. Wallgren on the peat pits, the accompanying map has been drawn, showing the location of the most convenient power sources. The water power sources are indicated by a circle containing a dot, and the peat stations by a black circle. The following table gives the most important data of these stations:

No.	Length of road to be fed, miles.	H.P. at generator shaft required, maximum.	H.P. at generator shaft obtainable, minimum.	Distance from railroad, miles.	No.	Length of road to be fed, miles.	H.P. at generator shaft required, maximum.	H.P. at generator shaft. obtainable, minimum.	Distance from railroad, miles.
1	96	3,100	5,000	6	12	83	4,000	.....	..
2	107	4,050	66,000	12	13	61	3,450	1,550	4
3	151	4,150	8,000	1	14	119	4,400	6,000	1
4	128	2,950	14,000	12	15	115	5,600	6,000	1
5	115	3,550	12,000	5	16	118	3,550	1,460	1
6	165	3,450	110,000	1	17	226	9,800	75,000	10
7	145	4,600	22,000	1	18	135	4,050	.....	..
8	208	7,400	90,000	1	19	89	4,750	.....	..
9	72	2,750	2,500	1	20	132	6,050	6,500	5
10	226	9,300	19,000	25	21	65	4,000	.....	..
11	62	2,500	1,800	6	22	73	4,800	.....	..
					T't'l,	2,691	102,000		

Nos. 12, 18, 19, 21 and 22 are peat stations. The horse-power needed are calculated according to the present railroad time tables.

The greatest distance from any one power station to the most remote point of its district is 100 miles. This makes possible that in case of emergency neighboring stations can help each other.

The estimate of cost is made for the Ward Leonard system and for a feeder tension of 40,000 volts and a contact line tension of 7,500 volts, although the voltages probably could be taken considerably higher—60,000 and 15,000 volts respectively. The frequency is supposed to be 25 periods per second. The most important figures of the estimate are the following:

Cost of water power: 1-H.P. at generator shaft per year.....	$10.00
Cost of peat power: 1-H.P. at generator shaft per year	19.50

These figures include interest, amortization and repairs of the complete power house. If the electric system is adopted by degrees, so that when new motive power is needed electric locomotives will be added, no extra cost will arise for the rolling stock. The estimated outlay for feeders, transformers, contact lines and everything connected therewith is $13,500,000.

The operating expenses per year will thus be:

3½% interest on $13,500,000	$473,000
Sinking fund and repairs	473,000
80,400-H.P. water power	804,000
21,600-H.P. peat power	420,000
Additional cost of administration and extra costs	181,000
Total	$2,351,000

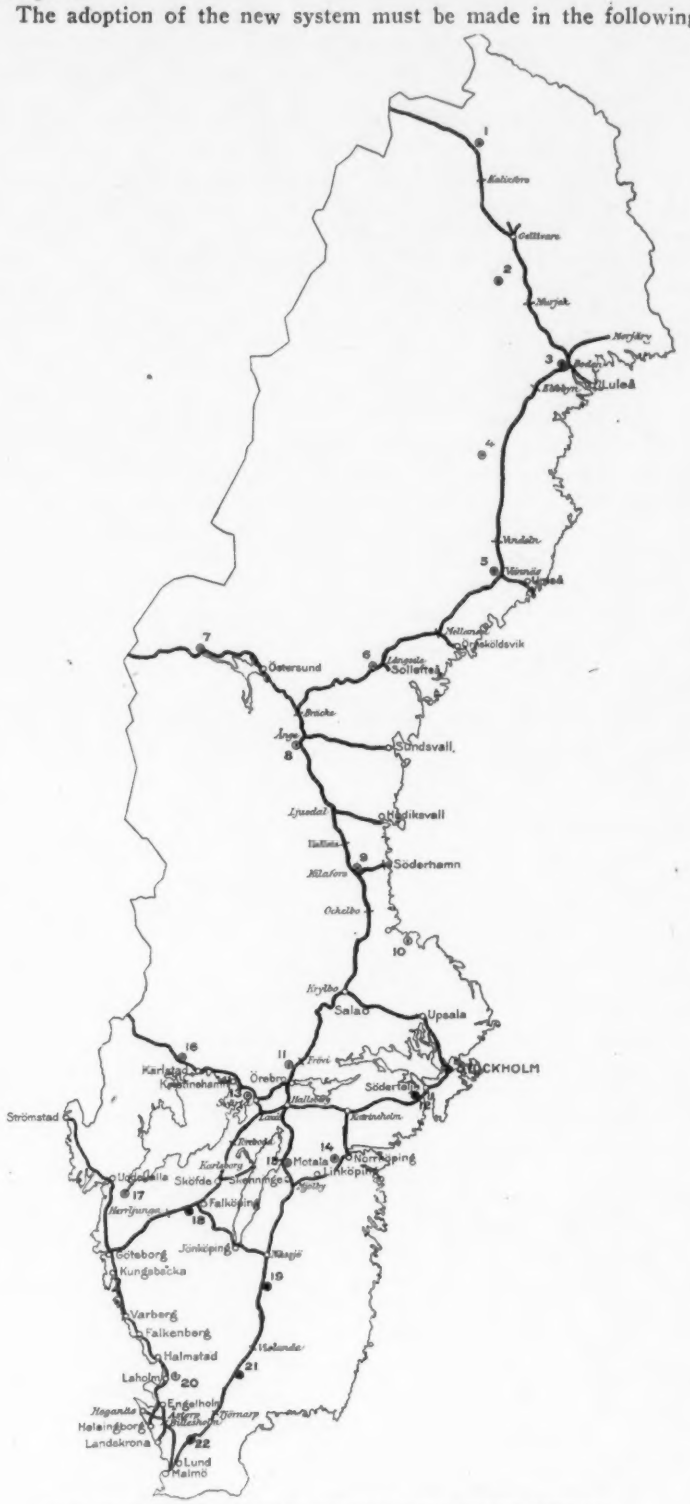
The saving by introducing the electric system depends chiefly on the price of coal, which some years ago reached $6.75 per ton, but now has gone down to $4.05. Supposing the latter price to prevail, the saving would be $1,950,000 per year; or with coal at $5.40 per ton, the saving would be $2,400,000.

An approximate estimate of the operating expenses per year with the Lamme system shows the sum of $2,030,000.

These figures are for the entire railroad system, while for some sections of it the conditions are much more favorable for electric traction. It is unquestionable that the traffic of the railroads will increase considerably after the adoption of the electric system, and the operating cost will not increase in the same proportion.

Based on the calculations made, Mr. Dahlander expresses as his opinion that, by using a single-phase current system, it will soon be possible to operate the Swedish Government roads cheaper than at present. But even if this were not the case, the national economical gain resulting from the electric system—coal importation for railroads then being no longer necessary—would be reason enough to accept it.

The adoption of the new system must be made in the following way, in order to avoid throwing away useful material: When new locomotives are required, electric ones are to be provided for use on a section electrically equipped. Interest and amortization of the capital expended will then be paid by the saving in operating cost.



MAP OF SWEDISH RAILWAY SYSTEM WITH POWER SOURCES.

Finally, Mr. Dahlander suggests further investigations in the matter and arrangements for experiments on electric traction on a short section of the government roads.

Mr. Dahlander's report is published in extenso in the Swedish periodical, *Teknisk Tidskrift*, of January 10, 17 and 24. From this publication I have made this abstract.

Meeting of Independent Telephone Association of Maine.

At a meeting of the above-named association at West Paris, Me., March 9, the following officers were elected for the ensuing year: President, Lewis A. Goudy, Northeastern Telephone Company, Portland; first vice-president, R. L. Cummings, Citizens' Telephone Company, South Paris; second vice-president, P. C. Chandler, Pine Tree Telephone Company, New Gloucester; secretary, E. L. Durgan, Northeastern Telephone Company, Portland; treasurer, F. L. Wyman, West Paris and Curtis Hill Telephone Company, West Paris. Executive Committee—B. G. McIntire, Waterford; John H. True, New Gloucester; Dr. F. H. Packard, West Paris; E. W. Gross, Auburn; E. L. Tibbetts, Lewiston; George H. Jones, Oxford; H. C. Cook, Casco.

A unanimous vote of thanks was extended to President Goudy for his explanation of the independent telephone situation in Maine and New England, and he was authorized and requested to represent all independent telephone companies who are members of the association, none of which are in affiliation with or under contract to the New England (Bell) Company, or its allies or licensees, the Eastern Company and others, who have sold out to or become under branch line contract with the New England and are thereby controlled by it.

The independent companies, for whom Mr. Goudy is authorized to appear as advocating the "repeal of the un-American monopoly law" which was placed on the statutes of Maine in 1895, are the Northeastern Telephone Company, Pine Tree Telephone Company, Curtis Hill & West Paris Telephone Company, Bryant's Pond & Paris Telephone Company, Greenwood & Woodstock Telephone Company, Citizens' Telephone Company, South Paris, Norway Local Telephone Company, Paris & Sumner Telephone Company, East Milton Telephone Company, Greenwood Local Telephone Company.

With regard to the status of the association, Mr. Goudy writes us as follows:

This association was organized in October, 1901, with Mr. M. S. Bird, of the Eastern Telephone Company, of Rockland, Maine, as its president, intercommunicating contracts having been made by the Eastern Company with many of the rural and village exchange lines. A short time after these contracts were executed, the Eastern Company merged its interests with the New England Telephone & Telegraph Company, licensee of the Bell Company.

This action created a great deal of bitter feeling on the part of the rural companies, who had thus been led into an alliance with the Bell monopoly, which demanded the discontinuance by the independents, of their own transmitters, substituting therefor the Bell transmitters. The refusal to accept such conditions led to the Bell Company refusing to transmit messages. This in addition to increase of toll charges and advance in rates at certain points, has created a decided agitation against the New England (Bell) Company, and the Eastern, its latest acquisition. Mr. Bird did not resign the presidency of the association, but he was superseded, at their recent meeting, by L. A. Goudy, vice-president and general manager of the Northeastern Telephone Company, which is the only independent company, with broad state charters, in New England.

The Northeastern Company is building trunk lines and installing large exchanges in the principal cities in Maine, beginning with Portland, using the Strowger system for its large exchanges, and the manual and selective party line systems for its village exchanges and rural service. It will expend nearly half a million dollars on its new exchanges and installation of its system in Maine and New Hampshire during 1903. It is an aggressive representative of the rural, independent companies, which it is working in harmony with for the expansion of independent telephony.

The New England Company has been forced to join in the repeal of the so-called "monopoly law" of Maine, whereby any other company in the State is debarred from entering into competition with or paralleling the lines of the Bell system. This piece of un-American legislation has been wiped out through the aggressive action of the independents, supported by the Maine State Grange (which desires rural telephone connections). Immediately in connection with this action, however, the move was made by the Bell Company to engraft seriously hampering legislation, whereby this company, its allies or representatives, could force suspension of construction of lines by appeal from the decisions of municipal officers of towns and cities, granting rights to independent companies, to the Supreme Court, which would cause long delays and discouraging results. This action is being sharply opposed by the Northeastern Telephone Company and others in harmony with its policy for broader expansion of the telephone business.

American Electrochemical Society.

The third general meeting of the American Electrochemical Society will be held April 16-18, in the assembly hall of the Chemists' Club, 108 West One Hundred and Fifty-fifth Street, New York.

On Thursday evening, April 16, there will be a reception of members and guests in the parlors of the German Liederkranz, followed by a subscription banquet in the same building, at $5 per plate. On Friday evening the society will, by special invitation, be the guests of the American Institute of Electrical Engineers at their extra meeting, held in the assembly hall of the Chemists' Club, at which, after an introduction by President Scott, Mr. W. J. Hammer will read a paper entitled "Radium and Other Radioactive Substances, and Certain Phosphorescent and Fluorescent Substances; The Properties and Applications of Selenium; The Treatment of Disease by Ultra-Violet Rays." On Saturday evening Prof. Jos. W. Richards will deliver his presidential address, after which there will be a demonstration of the Cooper Hewitt mercury lamp by Dr. Max von Recklinghausen. Later in the evening there will be a German-American smoker (Kneipe) at the Chemists' Club. Following is a list of the papers thus far announced:

Constant Voltage and Constant Current Separations, by Wilder D. Bancroft. Experimental Study of Some Electrode Effects, by H. T. Barnes, Ph. D. The Electrolysis of Water, by J. W. Richards, Ph. D., and W. S. Landis. Experiments with Metallic Diaphragms, by Wilder D. Bancroft, Ph. D. The Protective Action of Zinc Chloride on Metallic Iron, by C. J. Reed. Insulating Materials; A Field for Chemists, by M. Von Recklinghausen, Ph. D. A Historical Review of the Storage Battery, with Illustrations, by H. B. Coho. The Use of Pyroxyline in Electric Storage Batteries, by Elmer A. Sperry. The Concentration Changes in the Electrolysis of Brine, by W. H. Walker, Ph. D. The Influence of Some Impurities in Salt Upon the Yield of Soda by the Amalgam Process, by J. W. Walker, Ph. D. The Corrosion of Metals by Electrolysis, by A. A. Knudson. Modern Electrolytic Copper Refining, by Titus Ulke, M. S. Note on the Composition of Electroplating Solutions, by N. S. Keith, Ph. D. The Formation of Nitric Acid Under Electric Influences, by C. W. Volney, Ph. D. Note on Electrical Endosmose, by Wilder D. Bancroft, Ph. D. Ions and Electrons, by Louis A. Parsons, Ph. D. Uniformity in Electrochemical Equivalents, by Carl Hering. Electromotive Force of Alloys, by W. D. Bancroft, Ph. D. Electrolytic Production of Metallic Compounds, by C. F. Burgess, E. E., and Carl Hambuechen, Ph. D. The Electrodeposition of Metals Upon a Rotating Cathode, by J. G. Zimmerman. Electrolytic Conduction Without Electrodes, by A. B. Marvin. A New Type of Electrolytic Cell, by P. G. Salom. Potentials of Zinc in Aqueous Solutions, by H. E. Patten and W. R. Mott. Notes on Electrolytic Deposition of Nickel, by Woolsey McA. Johnson. What is the Capacity of Molecules for Electric Charge in Electrolysis, by Alfred H. Cowles. Exhibit of Aluminum Corrosion, by J. A. Steinmetz. Exhibit of New Apparatus, by A. Eimer.

Reasons for Travel Congestion in New York.

An interesting address was delivered before the Men's Club at the Judson Memorial Church, last week, by President H. H. Vreeland, of the Metropolitan Railway Company, on "slow trolleys" in New York City, and the reasons for them.

"Street railroads were never built for rapid transit," said Mr. Vreeland. "They were never intended for it. In spite of the fact that the average headway in New York City is closer than in any other city, and with cars running at an average speed of eleven miles an hour, there is not an electric line in the city below Twenty-third street where the cars can be operated under present street conditions as fast as the horse cars of ten years ago."

He told of the increase of the traffic of the city from thirty-seven to one thousand millions a year. Illustrating the proportion, he said that on last Wednesday there had been eighty thousand more passengers carried by his company than for the same day in 1902.

"You will readily see," continued Mr. Vreeland, "that the opening

of the subway is only a question of a day, for by the end of this decade one thousand millions of passengers will have to be moved a year in the boroughs of Manhattan and the Bronx alone. The total number of passengers a year on all the steam railroads in the country is only 620,000,000.

"Not only must provision be made for the traveling of the two millions of inhabitants of Manhattan and the Bronx, but for fifty per cent. of the population of the cities and towns within fifty miles of the metropolis. The people of those outlying cities come here for their shopping, their work and for their amusement.

"Newark, with a quarter of a million of inhabitants, has only one theatre; Brooklyn, with more than a million, has only four theatres, and Yonkers, a flourishing little city, has one music hall, where occasionally a traveling company gives a performance. To-night sixty thousand persons are sitting in theatres along the line of Broadway from Fourteenth to Forty-fifth Street. They will all wish to go home at once. No matter how many cars we run, they are all full."

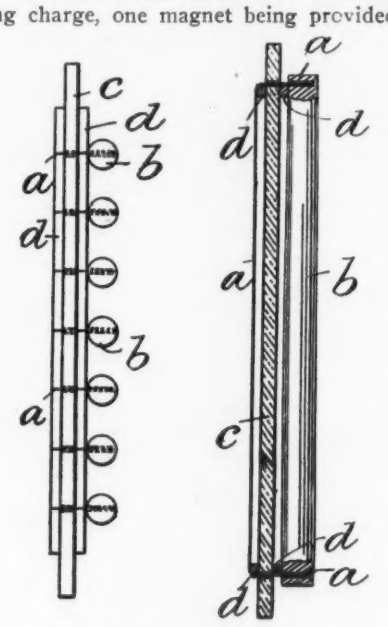
Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

ELECTRIC FURNACE.

An electric furnace designed by Albert A. Shade, of Chicago, for fusing the raw materials of glass manufacture, is a modification, and in some respects a simplification, of the furnace of the same inventor, described in the issue of November 29, 1902. Essentially the new construction comprises an inclined tubular conduit through a fire-brick pier, the conduit being fitted with means for the introduction of the charge and the withdrawal of the melt, and several intermediate pairs of axially aligned electrodes for accomplishing the fusion.

Several gas burners are provided in the portion of the conduit above the electrodes for the preliminary heating of the charge, and a jacketed conveyor and hopper provide for the more complete utilization of the heated gases. Magnets placed within recesses in the fire-brick beneath the conduit direct the several arcs downwardly upon the moving charge, one magnet being provided for each arc,



IMHOFF BIPOLAR ELECTRODE.

and its effect confined thereto by shields consisting of iron plates interposed between the magnets. Aside from details of construction, the furnace differs from that heretofore described mainly in the omission of any means for retarding or momentarily arresting the progress of the charge as it comes into proximity to the successive arcs.

BIPOLAR ELECTRODE.

Dr. Paul Imhoff, of Liverpool, whose work in relation to the electrolytic production of chlorates is well known, now offers a bipolar electrode intended particularly for this work, the construction being such as to economize platinum as much as possible. Platinum alone has been found suitable for use as the anode in the electrolysis of brine under any conditions capable of giving rise to oxygen or to oxygen compounds of chlorine, and its increasing cost lends importance to every effort made to reduce the quantity required. In this country, platinum in the form of foil of extreme thinness backed by sheet-copper is used, but abroad the tendency is toward the use of the metal in the form of wires, strips or gauze. Such open construction necessitates the interposition between the positive and negative sides of the double electrode of a non-conducting partition plate, faced on the one side by the platinum anode and on the other by the cathode of base metal or carbon, these two faces being in metallic connection through or around the plate in order that the electrode as a whole when placed in the electrolyte between the positive and negative leads may acquire opposite polarities on opposite sides.

In the construction shown in the accompanying figures the supporting plate, *c*, of glass or slate is fitted with ribs or distance strips, *d*. The anode wires, *a*, of platinum on the one side, and the cathode bars, *b*, of iron or carbon on the other, rest in contact with these distance strips, and are firmly bound in position by leading the platinum wires through or around the plate and firmly attaching them, by soldering or otherwise, to the bars. This construction not only gives a unitary structure capable of being removed bodily from the bath, but provides an effective electrical connection between the opposite sides of the electrode. The novelty of the invention is not broad, being substantially limited to the means by which the conductive faces are bound together by leading the platinum wires through or around the dielectric plate. In this art, however, the small advances merit consideration.

Dutch Cable Landing at Guam.

Formal application has been made by a Dutch cable company to the United States Government for permission to land a cable at the Island of Guam to connect with the transpacific cable now in course of construction. The other end of this cable will be at Marshall Island, in the South Seas, where it will connect with the Dutch and German systems of cables already laid.

The Department of Justice has decided to grant this landing right, but at the Navy Department there is a feeling that it is not altogether wise from a naval viewpoint to permit the Dutch company to establish a station at Guam. For this reason certain charts and soundings which the Dutch company desires to use in laying the cable have not yet been turned over to that concern. The Navy Department before doing so will consider the effect of the Dutch cable from a strategical point of view.

Germany and Holland are operating hand in hand in their policy of constructing cables, which will give them cable connection with their possessions in the East, independent of the English cables. Two-thirds of the total cable lines of the world are under English control. German companies, which in time of war would be forced to allow the German Government to control their lines, have already laid many lines in the South Seas, but even by using all the available Dutch cables they have yet no cable communication independent of English connections from the Orient to Berlin.

If a Dutch cable goes into Guam, Germany will have a line of direct communication from her South Sea possessions to Berlin without resorting to English controlled lines. The conditions under which the Commercial transpacific cable will be laid are so specific in regard to its control by the United States in time of war that the officers of the Navy Department who have been most concerned in the drawing of the contract under which the cable company will lay the cable are anxious to do nothing which will in the least interfere with the interests of the United States in time of war.

Apparatus for Johns Hopkins.

The department of physics at the Johns Hopkins University has received from the widow and daughter of the late Dr. William T. Barnard, some apparatus for the physical laboratory, consisting of several dynamos, motors, etc., which were originally designed to be used in connection with a system of multiplex telegraphy. The plans for establishing this system were abandoned shortly before the death of Dr. Barnard. Mrs. Rowland, widow of the late Prof. Henry A. Rowland, has given to the university the splendid collection of her husband's books on physics.

New Telephone Patents.

Of the four telephone patents of the issue of March 10, two by the same inventors, Messrs. C. L. Goodrum and J. W. Lattig, are very closely allied, covering respectively a novel central energy telephone system and a party line lock-out subscriber's station apparatus, primarily adapted to operate in connection with this system.

In almost all central energy systems the line signal is restored through the agency of a cut-off relay or cut-off joints in the spring jacks, which devices either cut the line signal apparatus entire from the circuit or open the circuit of the signal itself, independently of the actuating relay. In this system of Messrs. Goodrum and

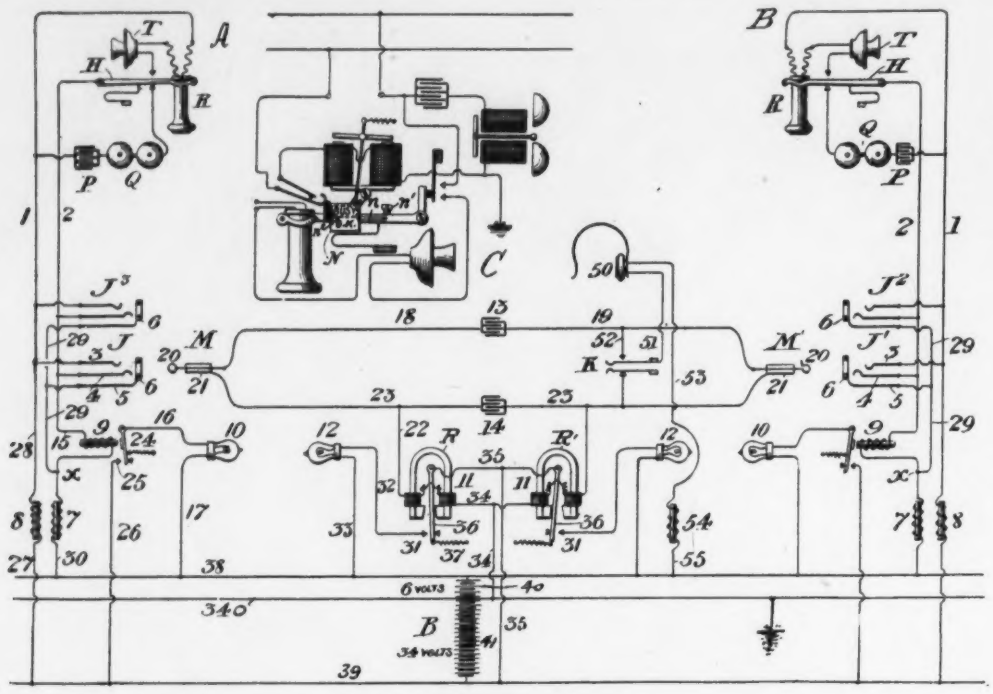


FIG. 1.—DIAGRAM OF CIRCUITS.

Lattig the retirement of the line signal is accomplished by an entirely different plan, viz.: by arranging the circuits so that the line relay winding is strapped by a shunt of very low resistance upon the insertion of a plug in the spring jack. The working of the supervisory or cord signals of this system is also novel. These features may, however, be best explained from a diagram of circuits such as shown in Fig. 1.

Considering first the shunted line signal feature, it is seen that a circuit is traceable from the exterior terminals of the two batteries, 40 and 41, in series, as follows: Wire 39, coil 8, wire 1, subscriber's set *A*, wire 2, relay 9, wire *X*, coil 7, and wire 38. This circuit is normally open in the subscriber's set, but upon the removal of the telephone from the hook switch, current flows, operating relay 9 and displaying the line signal, 10. Now it is noticeable that the spring jack consists of three elements or contacts, while the corresponding connecting plugs contain but two. The insertion of a

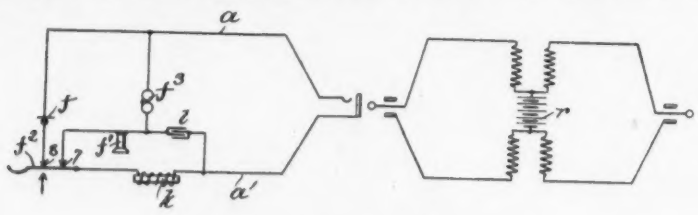


FIG. 2.—DEAN SUBSCRIBER CIRCUIT.

plug in a jack results, therefore, in a short-circuiting of the jack spring, 4, with the jack thimble, 6. An examination of the wiring shows that this short circuit is a shunt upon the line relay. The insertion of a plug in the jack thus deprives the line relay of all but a most insignificant current and the relay armature falls back, extinguishing the light.

The operation of the supervisory signals is not quite so simple, depending upon a selection of resistances for the various pieces of apparatus, and upon a choice of potentials for the two batteries such that an oscillation of the subscriber's hook switch will cause reversals of the current in the polarized relay, *R*. First, consider the condition when the line circuit is open at the station, *A*, and a plug is in the jack. At this time there is a closed circuit existing as follows: From the six-volt battery, through bus-bar 38, coil 7, jack *J*, plug *M*, wires 23, 22, and relay *R*, back to the battery. The current which flows in this circuit is designed to operate the relay, *R*, and light the lamp, 12. Now, when the line circuit is closed at *A*, however, the six-volt battery does not operate independently, but operates in series with the thirty-four-volt battery. Under this condition, therefore, there is forty volts effective upon the coil, 7, and thirty-four volts upon the relay, *R*, both sending their currents jointly through a path consisting of the subscriber's line and the coil, 8. Of course, with this reversed current the polarized relay fails.

This reversal of currents is accompanied by fluctuations of potential at the subscriber's station, and the inventors have based the operation of their lock-out device upon this fluctuation. The lock-out device itself, also shown diagrammatically in Fig. 1, is a polarized, hook-switch lock, the winding of which is momentarily connected to ground during each movement of the hook-switch. If, when the line is in use, and this contact be closed, a current will flow when the switch has closed its first contact, which current will help retain the bolt in the locked position. If the line is free, the current will be in the opposite direction, will withdraw the bolt, and allow the hook to complete its motion and close the talking contacts. If it becomes necessary to allow a second party upon the line to come into the connection, by an arrangement of keys at the central station, the operator may restore the potential temporarily to the normal direction, until this second station has responded, when upon the release of the key the potential becomes again reversed.

Fig. 2 shows a subscriber's circuit which is the subject of a patent issued to W. W. Dean and assigned to the Kellogg Company. In this circuit the receiver in series with a condenser is placed in shunt about a low-resistance, high-retardation coil, *K*. By this means the rapidly-fluctuating voice currents coming upon the inductance of the coil are caused to flow through the receiver circuit, while the steady portion of the direct transmitter current passes without obstruction through the coil, being withheld from the receiver by the condenser. With this circuit the receiver coil and cords are relieved of the effects of the relatively large magnitude direct currents.

The fourth patent of this issue shows a new departure in receiver supports for telephone sets, as the design is apparently based upon the supposition that the mouth of the receiver and that of the transmitter should occupy substantially parallel planes when in use. Now, while doubtless many telephone users place themselves in a position such that this condition is fulfilled, every telephone man knows that it is an improper position; for with the considerable mass of material comprising the buttons of modern transmitters it is quite essential for best results to project one's speech directly into the transmitter, that sufficient energy may be impressed upon the diaphragm to move the parts appreciably. This consideration alone would count heavily against the new device.

Extensive "Postal" Plans.

Announcement is made by the Postal Telegraph Company that construction work will soon begin on its main trunk line from Omaha to San Francisco, which is to be a connecting link of a cable and telegraph system that will span the globe. It will connect at Omaha with heavy through lines from Chicago to New York and on the West with the Pacific cable now being laid between San Francisco and the Philippines and China. The wires will parallel the Union Pacific right of way. Poles have already been unloaded from Omaha to Julesburg, Colo.

A Proposed Municipal Lighting Plant for New York.

At a meeting of the Board of Estimate and Apportionment, of New York City, last week, Mr. R. G. Monroe, Commissioner of Water Supply, Gas and Electricity, made a report on the subject of electric lighting, in which he urged the establishment of a municipal plant. The report, which is not yet in print, was accompanied by copious data from Chief Engineer Lacomb. In the course of it Mr. Monroe said: "Within the last five years the lighting interests in this city have all practically united, and even in those boroughs where there has been no formal consolidation the territory has been apportioned. In Manhattan both illuminants have been absorbed by a single corporation, and there is no rivalry even between producers of gas and producers of electricity. The Consolidated Gas Company of New York controls all the gas and electric light facilities in Manhattan, as well as all gas and electric light facilities in the more important sections of the Bronx. As far as gas light is concerned, not only does the price remain fixed, but all improvement in the utilization of gas is retarded."

After treating of the prices charged the city for gas, the Commissioner says that electricity is the illuminant of the greatest importance for public lighting, and adds that $2,000,000, or 60 per cent. of the entire appropriation for the year, will be expended for electric lighting.

"In Manhattan the price bid for a 2,000-cp lamp is $146," said Mr. Monroe. "The price in Brooklyn for a 1,200-cp lamp is $124.50. I have obtained from sixty-eight cities the prices paid to the various electric light companies for supplying these cities with 2,000-cp lamps, and the average price is $88.60. In twenty-three other cities using 1,200-cp lamps the average price is $81.08.

"The combination which now imposes exorbitant prices upon New York is formidable, but, to my mind, its strength is more apparent than real. The capitalization of the electric light companies in our city may be best exemplified by the New York Edison Company. It is now capitalized at $45,200,000 in stock, subject to $40,138,000 bonds, making the total $85,338,000."

On the question of municipal ownership the Commissioner said:

"If the City of New York would undertake to supply itself with electric light its interest charges would be limited to the amount actually expended on its plant, and it would not be burdened with the necessity of declaring dividends on watered stock. In Manhattan the electrical conductors would be carried through the existing subways without incurring any expense by way of rental for the space occupied.

"These subways are divided in ownership between two subway companies, but each of them is bound by its franchise to, without charge, supply to the City of New York all space in said subways necessary for its electrical conductors and the electrical conductors of each separate department of said city which may now or hereafter be required.

"I am informed by officers of the Edison Company that the subway rentals for electrical conductors which are now used for city lights amount to $100,000 a year. If the city had an electric light plant the cost of distribution would be reduced by that amount."

In conclusion, he remarked:

"I believe New York with its own plant could provide electric lighting for public uses at a cost much below what is now charged to the city. Whether reasonable prices can be obtained from private companies, or whether the city can with better results maintain and operate its own plant, is for you to determine. I do, however, urge that legislation be immediately asked and that you be given the power to establish and maintain an electric plant for street lighting, in case later you decide that it is in the interest of the public so to do."

Acting on this report, which has, it is said, the approval of Mayor Low, Comptroller Grout and some other city officials, surveys have been made for a plant on Blackwell's Island in the East River, of a capacity rumored to be not less than 15,000 kw, and distributing current to both sides of the river by submarine cable.

At Albany on March 17, Commissioner Monroe said that he expected to bring his bill for a municipal electric lighting plant to Albany on Thursday. Assemblyman Hornidge told the Commissioner that he was opposed to using Blackwell's Island as a site for the lighting plant. He said he thought that Blackwell's Island was ultimately destined to become the great playground of New York City and Brooklyn. Mr. Monroe said the naming of Blackwell's Island as the site for the lighting plant was only tentative. It was done merely that there might be some basis upon which to make computations of the cost of the service. It had seemed to him, he said, that Manhattan, Brooklyn and Queens could be more readily served from a plant on Blackwell's Island, but he did not propose to become involved in any controversy over the site. There were many sites which were available and any one of them would be acceptable to him.

CURRENT NEWS AND NOTES.

TRAIN TELEGRAPHY.—An enterprising stock broker is said to have made application to furnish stock quotations to the "Twentieth Century Limited" on the New York Central as soon as a wireless telegraph system now in course of preparation for this train shall be completed, and it is said that a news ticker service is contemplating similar action.

ST. LOUIS EXPOSITION.—The installation of the first exhibit of the Exposition began on March 10. A force of workmen in the employ of the Electrical and Mechanical Department, under Mr. Henry Rustin, unloaded and conveyed to the temporary boiler house the big marine boiler sent to St. Louis by the Duesseldorf-Ratinger Rohrenkessel Fabrik, of Germany. The boiler will be placed at once on the concrete bed which it is to occupy to the end of the Exposition. It will do service in lighting the Liberal Arts Building and the grounds for the dedication ceremonies.

STATE AND COUNTY CIVIL SERVICE EXAMINATIONS.—The next general examination for New York State and County service will be held on April 4, 1903. The following positions are included: Architectural draughtsman, assistant electrical engineer, assistant steam engineer. Persons desiring to enter these examinations must file applications in the office of the State Civil Service Commission in Albany before noon of March 30th. Application blanks and information regarding salaries and requirements of examinations may be obtained by addressing the chief examiner of the commission at Albany.

WIRELESS TELEGRAPHY IN NEW YORK CITY.—The Marconi Wireless Telegraph Company has made a practical test of the wireless system by sending messages from the steamship Umbria, lying at her dock in the North river near Christopher street, to the 20th floor of the Broad Exchange Building, an air line of probably one mile, with numerous tall steel buildings in between. On the roof of the building was stationed a receiver and an operator, and the messages were taken from the top of the flagstaff. The demonstration was a success, a number of mesages being received without interruption and with no delay.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The following candidates were elected members of the American Electro-Chemical Society at the March meeting of the council: A. S. Garfield, Paris, France; Louis S. Cates, Parral, Chih., Mexico; Lee Shepherd, Midland, Mich.; John L. Clayson, Philadelphia, Pa.; F. J. Davis, Lockport, N. Y.; John J. Riker, New York; W. R. Mott, Madison, Wis.; C. F. Carrier, Jr., Bethlehem, Pa.; H. M. Backus, Bayonne, N. J.; J. W. Aylsworth, East Orange, N. J.; E. N. Dickerson, Stovall, N. C.; Wm. Battle Phillips, Austin, Tex.; C. R. Walker, Cambridge, Mass.; Walter G. Graves, Cleveland, Ohio; Albert Finck, Cleveland, Ohio; D. R. Warmington, Cleveland, Ohio; Prof. C. F. Mabery, Cleveland, Ohio.

REQUEST FOR MOLYBDENUM.—Consul E. N. Gunsaulus sends from Toronto, February 24, 1903, a letter from Mr. W. B. Bentley, 72 Queen Street W., Toronto, as follows: I am interested in molybdenite and actinolite properties, of good quality, in Ontario. Molybdenum, as you know, was formerly used in the dyeing of silks and cottons, but its recent application to the production of a peculiar high-grade steel, rendered possible by recent advances in electro-metallurgy, has resulted in molybdenite emerging from its position of comparative obscurity as a rare mineralogical specimen to an article of great commercial value. I desire to get into communication with the various dealers (chemical companies, I presume) in the United States who handle this mineral, and would be greatly obliged if you would forward my inquiry to the proper parties.

ACCESSIBILITY IN NEW YORK STATE.—The State of New York contains 50,000 square miles of area, and this area is made accessible to its people for transportation purposes by 522 miles of canals, 1,718 miles of street railways, 8,114 miles of steam roads and 73,857 miles of dirt roads. The relative cost of transportation to-day is alleged to be as follows: $1.25 will carry a ton of produce 5 miles by horse-power; 25 miles by electric power; 250 miles by steam railroads, and 1,000 miles by steamship. It is proposed to bond the State for $5,000,000 a year for ten years and spend the money on the highways.

WIRELESS TELEGRAPHY IN ENGLAND.—In regard to the refusal of the General Post Office to give the Marconi Wireless Telegraph Co. the same facilities as are accorded to the cable companies, it is stated by the authorities that the former company did not ask for the same privileges as the cable companies enjoy. It demanded an "exclusive license," such as no cable company enjoys. If this were granted, it would prevent the Government from making similar concessions to any competitors of the wireless company, and the General Post Office declined to support a commercial monopoly. This seems to be the same tack as was taken in regard to the Bell telephone.

LETTERS TO THE EDITORS.

Tesla Split-Phase Decisions.

To the Editors of Electrical World and Engineer:

SIRS: The news statements in respect to the recently decided Tesla litigation seem to have been inspired and do not state the facts, inasmuch as they allege that the United States Court "in one circuit upholds his (Tesla's) patents, and in another does not." Thursday's decision by Judge Colt, in Boston, corroborates a prior decision by the United States Court of Appeals. Judges Townsend, Wallace and Cox, after a most exhaustive and thorough trial lasting four years, decides that Mr. Tesla failed to prove invention prior to the published description of the same invention made by Prof. Ferraris, of Turin, Italy. Prof. Ferraris held the chair of physics in the Academy of Sciences in Turin for many years. In Europe he is universally acknowledged to be the original inventor of the induction motor and power transmission system so largely used in this country, and which is described by the news statements referred to as "one of the greatest inventions of any age." All foreign scientific publications speak of the Ferraris motor, the Ferraris principle and the Ferraris system, for he invented, constructed and described his work several years before Mr. Tesla claims to have devised it. So fully and completely is this fact accepted by scientific men that a public subscription has been taken up in Europe (now completed) for the erection of a suitable statue to Ferraris in Turin. I myself have seen the original motors, models and drawings made by Ferraris in 1885, have personally talked with the men who saw these models in operation, and heard Ferraris explain them at that date. Furthermore, I know that when the Tesla people learned that Ferraris's discoveries antedated Tesla's claims, they purchased from Prof. Ferraris the right to patent his inventions in the United States. Instead of exercising this right to patent, they concealed his inventions and thus left Mr. Tesla free to claim the honor and public credit resulting from his alleged discoveries. I have the necessary proof to substantiate my statements, including an acknowledgment of payment received by Ferraris from the Tesla people "in consideration of the cessation of my (Ferraris) rights in the United States to my discovery of the transmission of power by rotary-field motors."

As for the Tesla meter mentioned, as far as I am aware Mr. Tesla does not claim to have invented a meter, nor has he any patents for a meter; but poses in a general way as the inventor of a system of power transmission. If this were true he should have been able to prove it in court. The courts have decided, however, in the patents at issue, that he failed to prove invention prior to the Ferraris publications published several years after Ferraris's original discovery.

WILLIAM STANLEY.

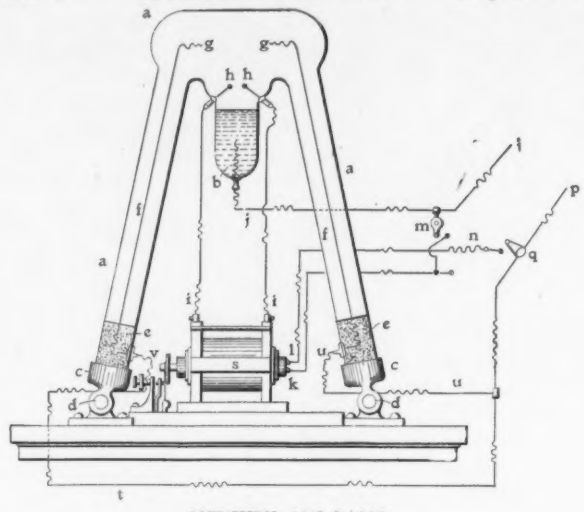
GREAT BARRINGTON, MASS.

The Mercury Arc.

To the Editors of Electrical World and Engineer:

SIRS: I have read with much interest the several articles on this subject, published recently in your columns, particularly that of Mr. Charles P. Steinmetz in your issue of February 21, for the reason that I have carried on a series of experiments during the past four years in the same line. The accompanying sketch shows a mercury arc lamp I made some three years ago, and exhibited to friends at my laboratory in this city. The lamp is on somewhat similar lines to the lamp illustrated by Mr. Steinmetz and attributed to Dr. Weintraub, of the General Electric Company.

In the series of tests that I have made, I believe I have demonstrated that the mercury vapor works more satisfactorily in the construction of lamp shown in the sketch. The partial vacuum



MERCURY ARC LAMP.

obtained in the construction of a mercury arc lamp creates a condition such that the vapor settles more satisfactorily downward to the terminals of the positive terminals, *e* and *e*, than if they were at the top of the lamp. For a starting device I used an induction coil, *s*, with spark terminals, *h* and *h*, within the vacuum tube connecting chamber, these terminals being just above the mercury cup, *b*. A condenser, *n*, was with the induction coil in circuit when desired through switches *m* and *q* with the positive and negative wire feed, *e*, return *y* and *p*. Instead of using a carbon filament as in the Weintraub lamp, I used a fine platinum wire. The starting terminals and induction coil need only be of small size, and instead of using a condenser and any connection with the circuit for lamp, a battery may be employed. Only a small spark arc is required to start the lamp; at least under the construction here shown that has been my experience.

You will note by the enclosed sketch that I employ two tubes joined to an egg-shaped central chamber in which the mercury is held in a cup-shaped member. I use graphite at the positive terminals of each tube. The lamp gives a beautiful light. I have some vital improvements which I do not care to divulge at the present time, but the lamp that I have briefly described and sketched was demonstrated over three years ago and has worked successfully ever since. It was 12 in. high.

LOUIS E. WALKINS.

SPRINGFIELD, MASS.

Fuel Consumption in Central Stations.

To the Editors of Electrical World and Engineer:

SIRS: It is extremely desirable that all central station data as to fuel consumption, kilowatt-hour output, etc., should be in terms of the pounds of water evaporated per hour, together with a statement of the pressure (or temperature) to which the water is raised; and if it is desired to be very exact, also a statement of the temperature of the water before it enters the heater or boiler.

In considering recently the results obtained in various stations and power houses, I found it extremely difficult to compare them with each other with a view to ascertaining the economy of operation, owing to differences existing in the quality and price of coal, and in some instances, in the types of boilers and heaters, firing, etc. All of these variable items are eliminated by using as a basis the pounds of water

evaporated from a given temperature to another given temperature. The station showing is thus divided into two parts, one the economy and cost of evaporation, the other the economy and cost of generation.

On this basis the pounds of water evaporated per kilowatt-hour output of the station is a factor permitting the direct comparison of stations using the cheapest and best fuel obtainable, with stations using the poorest and dearest fuel. By taking into consideration the load curve and class of machinery equipment, it can then be quickly determined whether or not a station is operating economically, and the relative economy of systems employing different methods of distribution, alternating and direct current, rotary converters and motor-generators, with and without storage batteries, can be determined.

Jos. E. LOCKWOOD.

DETROIT, MICH.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Heating of Machinery.—SCHNEPPEL.—An article on the different causes which influence the heating of dynamo-electric machinery. The surface exposed to the air, the temperature of the surrounding air, and the motion of the air through the parts of the machine are well known to be of great importance. He first gives the results of an elaborate investigation of the question whether the chemical material and the color of a paint is important. The result is that paint increases only slightly the capability of cooling of machines; the differences of the different colors are too small to have any important bearing; but it is important to use such paints as can stand a rise of temperature by about 80° C.; the paints used at present in practice fulfill this requirement. Of much greater importance is the motion of air, which varies with the speed of the machine, so that the degree of cooling is a function of the speed. This function of the speed is given by various authors in the following formula; the temperature, T, equals C divided by $h\ (1 + cv)$, when h is the surface in square centimeters per watt and v the velocity of the armature wires in meters per second. C and c are two constants, for which following numerical values are given by different authors: Arnold $C = 300$, $c = 0.1$; Kapp $C = 550$, $c = 0.1$; Esson $C = 354$, $c = 0.0006$; Wilson $C = 640$. $C = 0.18$. The present author concludes from his experiments that 0.1 is the most probable value for c; he did not continue his experiments in this direction.—*Zeit. f. Elek.,* February 8.

REFERENCES.

Parallel Running of Alternators.—FERNANDEZ.—An illustrated article on the parallel running of alternators. The author gives a simple illustration of the relation of alternators in parallel, showing why it is necessary to alter the relative positions of the field poles of parallel generators to vary the load on one of the pair. The article embodies much practical advice, and also shows a synchronizing arrangement usually installed for three-phase work, consisting of a lamp in series with a second lamp on the engine at the throttle, a synchronizer, and a voltmeter. The three devices are connected to the secondary of two transformers, the primaries of which are connected across the generator switch.—*Am. Elec.,* March.

Alternators.—LOPPE.—An article illustrated by a series of diagrams, in which he shows that if the no-load and the short-circuit characteristic curves are given, and if the existing current is known for a given load, it is possible to determine by a series of successive approximations, the exciting current for any load.—*L'Eclairage Elec.,* February 21.

Magneto-Electric Machines for Electro-Metallurgical Purposes.—An article giving some historical notes which show that engine-driven magneto-electric machines were used in the electro-metallurgical industry as early as 1844.—Lond. *Elec. Rev.,* February 20.

Commutator.—VICKERS.—An illustrated article on the casting of commutator segments.—*Am. Mach.,* March 5.

LIGHTS AND LIGHTING.

Arc Lamps with Impregnated Carbons.—ZIEDLER.—A long and profusely illustrated paper, read before the Berlin Electrical Society, on arc lamps with impregnated carbons, made by the General Electric Company, of Berlin. From the former publications on the Bremer arc lamp it is well known that the addition of materials like calcium increases considerably the efficiency of the lamps. The impregnated carbons used by his company differ from the patented Bremer carbons because the former carbons "contain additions only in the core and in such quantities and of such quality that they become entirely gaseous in the arc" so that no insulating deposits are left at the pointed ends of the carbon. Nothing is said concerning the chemical composition of these additions. For lighting the lamps it is sufficient to touch the two carbons and then separate them to a certain distance. There are two types of these lamps in use; in the one the two carbons are vertical one above the other as usual; they are called "flame arc lamps" (Flammenbogenlampen); in the other type the two carbons are placed inclined like the letter V, with the arc at the bottom; they are called "intensive flame arc lamps" (Intensivflammenbogenlampen). These lamps are made for direct current as well as for alternating current. Their construction is described and illustrated in detail; it does not differ very materially from the ordinary arc lamps of the same company; the differences which exist appear to be caused by the fact that in order to obtain a quiet, steady light, it is necessary that the ends of the carbons should have a comparatively small surface; for this reason the carbons used are thin, the same diameter being used for the positive as for the negative. On the other hand, the impregnated carbons are consumed more quickly than in the ordinary arc lamp. To get a life, convenient for the practice, it is, therefore, necessary to use long carbons; they are used in lengths of 325 mm or more, up to 500 mm (13 to 20 in.); to get a still longer life, lamps are made with two pairs of carbons; when one pair is consumed, the other one is automatically lighted. The construction of an "intensive flame arc lamp" with two pairs of carbons is shown in the adjoining diagram. The lamp contains two mechanically independent, differential mechanisms; electrically they are connected, the two main-current windings in series with the one or the other pair of carbons; the shunt windings are in parallel with the arc; all the coils are, therefore, always supplied with current, although only one arc is lighted; this necessitates a small waste of energy, but gives greater surety of working. In a 110-volt network there are 2 direct-current or 3 alternating-current lamps in series; in a 220-volt direct-current network, 4 or 5 in series; in a 220-volt alternating-current network, 6 flame arc lamps, or 4 or 5 intensive flame arc lamps in series. On the basis of these practical arrangements, he gives comparative tables of the hemispherical intensities of various lamps at 220 volts and 9 amp for direct-current intensive flame arc lamps, about two or three times the hemispherical intensity of ordinary direct-current arc lamps; for alternating current it is about 4 times as much. The adjoining diagram gives the results of measurements of the illumination of a surface by different lamps; the zero point of the axis of abscissas represents

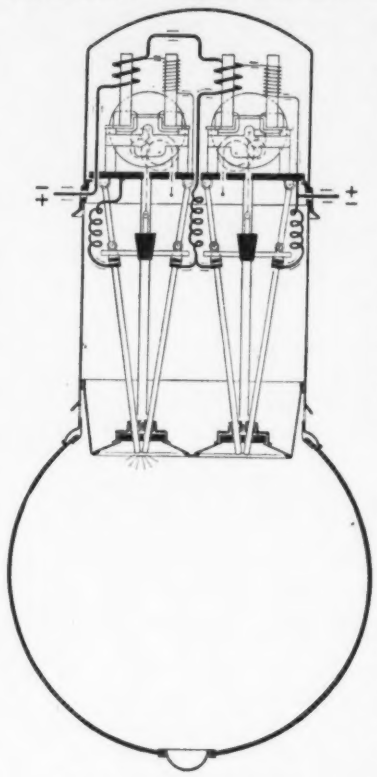


FIG. I.—ARC LAMP WITH IMPREGNATED CARBONS.

the point of the surface perpendicularly below the lamp, while the abscisas represent the distances in meters from this point; the ordinates give the illumination in luxex; *A* is for a 45-volt, 10-amp, direct-current intensive flame arc lamp; *B* for a 45-volt, 10-amp, alternating-current intensive flame arc lamp; *C* for a 40-volt, 10-amp, direct-current flame arc lamp; *D* for a 30-volt, 10-amp, alternating-

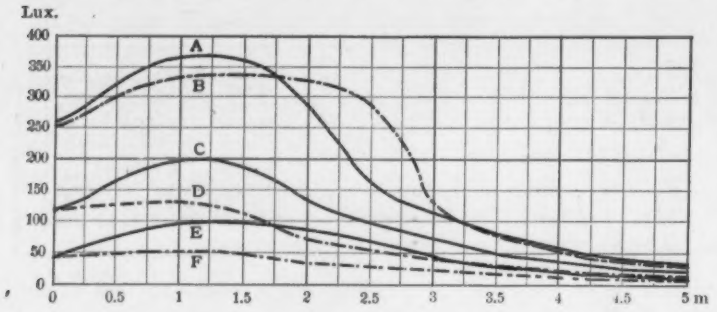


FIG. 2.—ILLUMINATION CURVES.

current flame arc lamp; *E* for a 40-volt, 10-amp arc lamp with non-impregnated carbons, and *F* for a 30-volt, 10-amp arc lamp with non-impregnated carbons. The intensive flame arc lamps are said to be especially suitable for advertisements and show window illumination.—*Elek. Zeit.*, February 26.

REFERENCES.

Alternating-Current Arc.—GUY AND MONARCH.—The first part of an account of an extended investigation of the alternating-current arc of very small intensity, between metallic electrodes. The results are given in diagrams and tables.—*L'Eclairage Elec.*, February 28.

Arc Lamp Regulating Mechanisms.—An illustrated article describing minutely the shunt and series arc light regulating mechanisms.—*Am. Elec.*, March.

POWER.

Combined Water Power and Gas Engine Plant.—An illustrated description of the water-power station at Goldach and the auxiliary plant at St. Gall, Switzerland. The hydraulic plant is located on the left bank of the Goldach at a place called Lochmühle, in the village of Untereggen. Two polyphase alternators direct-connected to turbines operating under a head of 417 feet, supply the current, which is transmitted from the Goldach station to St. Gall, three miles distant. On account of the variable supply of the water power, an auxiliary plant was installed at St. Gall, in which gas engines are used for supplying additional power required during heavy loading periods. This plant is so arranged that the engines are available for driving direct-current generators, either simultaneously with the three-phase motors or independently. The station at St. Gall is also equipped with a storage-battery plant, which acts as a regulator. A sub-station is also provided which contains motor-generator sets composed of polyphase motors and direct-current generators. The main station at St. Gall contains four gas engines having an aggregate capacity of 370 hp. One of the smaller combined generating and converting sets consists of two direct-current dynamos each of 40 kw capacity, either or both of which may be coupled to a 60-hp, three-phase motor. A 60-hp, single-cylinder gas engine is also arranged so that it can be used to drive one of this pair of dynamos by means of a clutch pulley, leaving the three-phase motor to drive the other one. A second group consists of two single-cylinder gas engines of 30 hp each, belted to motor-generator sets consisting of two three-phase motors of 30 hp each and two direct-current dynamos of 20 kw each. In this case the motors are capable of driving the dynamos at full capacity, whereas in the case of the set previously mentioned, the three-phase motor has only one-half the total ability of the dynamo part of the group. The third unit consists of a 66-kw dynamo, which may be belt-driven by a 100-hp, three-phase motor, or by a gas engine of similar capacity. The fourth unit consists of a double-cylinder, 150-hp gas engine, belt-connected to a 100-kw, direct-current generator, which may also be driven by means of a 150-hp, three-phase motor. For starting up the engines, a hand pump is provided by means of which a charge is compressed in the cylinder so that the engine may be started up by an explosion. A check prevents the engine from starting under the influence of the compressed charge until the charge is fired, at which instant the engine is automatically released. The fifth and sixth motor-generator units are not arranged for driving by gas engines. One of these consists of a 200-hp, three-phase motor direct-connected to two 65-kw direct-current generators, and the other a 250-hp, three-phase motor driving two 80-kw, direct-current generators. Both of the three-phase motors of these groups are of the squirrel-cage type and operate at 3,300 volts. The storage battery equipment consists of 300 cells arranged in four groups of 75 cells each for use on the lighting system, and 300 other cells, which are floated on the railway system in order to steady the demands on the generators and the voltage of the system. The sub-station contains three motor-generator sets, each comprising a 250-hp, three-phase motor, direct-connected to a six-pole, double-commutator, direct-current dynamo. There are also step-down transformers which reduce the three-phase line current from 10,000 to 3,400 volts, at which e.m.f. the three-phase motors in this station, as well as those in the main station, are supplied. The motors in the sub-station have wound rotors with slip rings. The high-tension line between the Goldach and St. Gall stations consists of three bare copper wires carried on a line of wooden poles located 105 feet apart. The municipal high-tension line is carried on single wooden poles; the conductors are carried on an overhead line to the St. Gall-Roschach Railway and then under the railroad track in a high-potential, triple-conductor cable, which is laid two feet beneath the surface.—*Am. Elec.*, March.

REFERENCE.

Electric Pumping.—An illustrated description of the electric pumping plant at the Bridgeport station in Chicago for the Illinois and Michigan Canal.—*Eng. News.*, February 19.

TRACTION.

Interurban Roads.—GONZENBACH.—The first part of an article on the Engineering and Preliminaries for an Interurban Electric Railway. The writer points out the necessity for making an accurate and conservative estimate of the income which can be derived from all possible sources of revenue. In the present case the estimate was based upon the actual results obtained in parallel cases, and the population of towns along the road was taken from the census returns supplemented by actual investigation. Another important point to be investigated is what will be required by the new enterprise in order to secure its share of patronage from competing railways as well as the development of new business. In the case under consideration, a train schedule was arranged providing for half-hour headway and a speed of thirty-five to forty miles an hour, with stops averaging every three miles. The equipment necessary for providing this service has been carefully figured out. Another important point considered in this paper is whether the third rail or overhead trolley should be adopted, and it is pointed out that in the matter of first cost, which often decides in favor of the trolley, there is an unconscious discrimination due to the fact that the conductivity of the circuit is lost sight of. For purposes of comparison, curves have been presented showing the difference in first cost between trolley and third rail, and it is interesting to note that the third rail is lower, even down to the smaller sizes. The chief advantage of the third-rail system is its low maintenance cost, and it is stated that when this fact is fully understood many roads now using trolleys in high-speed service will be warranted to change to the third rail.—*St. R'y Jour.*, March 7.

Present Practice in Interurban Electric Railroading.—BRIGDEN.—An article in which the writer refers to early steam railroad engineering when many roads were built with a gauge of 3 ft. to 3 ft. 6 in. Most of these roads had to change later to the standard gauge. He hopes that this experience will not be lost on electric railway companies who, while not building narrow-gauge roads, often put in a cheap initial construction. The grades, curves, etc., should be selected for a speed of 30 miles per hour, which trains on these roads will ultimately be required to make.—*St. R'y Jour.*, February 23.

Chicago.—An illustrated article on the modern shops and methods of the Chicago City Railway Company. The new plant is described, which has been erected in the suburbs, occupying about two and a half city blocks. It is easily accessible, however, and is surrounded on all sides by street railway tracks built for the purpose of admitting cars to the shops and car houses. A large portion is set aside for car houses, one of which has already been completed. The building is divided into independent departments, and a similar plan will be followed in the second building, which will really be a duplicate of the first and separated from it only by an alley. The repair shops comprise several buildings which have been located and arranged with a view of facilitating the handling of the work.

Tracks have been laid through the machine shop, blacksmith and frog shops for distributing and collecting the material, and another track runs the length of the mill. The tracks upon which the cars pass through the machine shops and other departments for repairs are all provided with pits. Overhead electric traveling cranes are also provided for carrying heavy machinery and material. A number of separate departments are taken care of in the machine shop building, including the truck repair department, motor repair department, and repairs pertaining to other electrical parts. An extensive brass foundry has been installed and several new smelting furnaces using oil for fuel. Babbitt metal is also melted in the brass foundry. An interesting feature in the machine shop is the pit construction. The equipment of the shops is the most complete of any in the country for street railway work. Provision was made for protecting the shops as thoroughly as possible from fire. Power is supplied for the operation of these shops from a special electrical plant consisting of two units of 300-hp each. A voltage of 500 has been adopted because of the possibility of using the regular railway current for the operation of the shops in case of a shut-down in the shop power house, and also for utilizing this power plant in case of emergency in supplying current to the lines for operating cars.—*St. R'y Jour.*, March 7.

Electrolysis of Water Pipes.—HAWLEY.—An article explaining in a popular way the corrosion of gas and water pipes by electrolysis due to strong currents from the return current of tramway systems. The only sure and efficient method of avoiding this is the double trolley system. With a single trolley system electrolysis may be reduced by perfecting the bonding of the return circuit and increasing the resistance of the pipe lines and by careful inspection. The responsibility for the damage by electrolysis has not yet been finally determined by the courts.—*The Polytechnic*, February 28.

REFERENCES.

Locomotives.—An illustrated article on electric locomotives for yard and shop work.—*Sc. Am.*, March 7.

An Electric Train Indicator.—PARHAM.—An illustrated article describing a device whereby passengers waiting on the platform or in the waiting-room of a station used in common by several lines of trains passing that station but for different destinations, may without danger or inconvenience to themselves or other passengers tell the destination of an approaching train, independently of colored lights, colored signs or any other destination marks carried by the train itself.—*Am. Elec.*, March.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging High-Tension Cables.—GARRARD.—A communication calling attention to the necessity of installing cable-charging gear. He says the only safe way to charge a high-tension cable is by means of non-inductive resistance connected directly in the high-tension circuit. As such only water rheostats need to be considered. The design of such a water rheostat is, however, a matter of no small difficulty. The best way is to choose such a value for the resistance as will charge each separate cable proceeding from the power house, so that one charging gear will do for all feeders; the resistance is such that the maximum pressure thrown suddenly on to the feeder, by the plunger of the rheostat coming below the surface of the water, is not more than say one-third of the working pressure. With these precautions no danger is to be feared. With the ordinary underground cables, however, the resistance required for this purpose is considerable and as ordinary water has to be used the column necessarily becomes very long and the insulating sleeves which direct the current flow are rather costly.—Lond. *Elec.*, February 20.

REFERENCE.

Isolated Plant.—An illustrated description of the power plant of the Wells Building in Milwaukee. There are one 100-kw, one 200-kw and one 250-kw direct-current generator, all operating at 250 volts. The three-wire system is used for distribution.—*The Eng.*, March 2.

ELECTRO-PHYSICS AND MAGNETISM.

Radio-Activity and Gravitational Energy.—GEIGEL.—An account of some experiments made with the object of determining whether the energy of radio-activity is derived from gravitational energy. He suspended a small bob of lead weighing 6.5 grammes over a watch-glass containing 1 gramme of radio-active substance and noticed a temporary diminution of weight amounting to 0.035 mgms. He supposes that "rays" of gravitational energy proceed from the whole earth towards the lead, and are partly intercepted by the radio-active substance. On this assumption he calculates the intercepting or absorbing power of the radio-active substance, varying the distance and dimensions of the substance for the purpose. The thickness of the radio-active layer varied from 3 mm to 21 mm and its width from 7 mm to 19 mm. He found that immediately after stirring the substance the loss of weight was greater, and also that some loss of weight remained after removing it. The writer of the abstract from which this is taken adds that the whole reasoning appears to be somewhat loose; if energy is absorbed, there should be a permanent loss of weight, unless its restitution is accounted for; if force only is intercepted, there is no loss of energy and no explanation of the radio-active energy; in any case a reduction of the radio-active surface does not bring about a smaller loss of weight.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 20.

Electrodeless Discharge.—DAVIS.—An account of some experiments on the electrical conductivity and absorption of energy in the electrodeless discharge. As an illustration of the great absorption of energy and the heating of the gas, he mentions the following experiment: A vessel was constructed having a thin platinum wire passing downward through the center; the passage of the electrodeless discharge heated the wire to incandescence in a few seconds.—*Am. Jour. Sc.*, March.

Changes of Temperature of Permanent Magnets.—LOOMIS.—An account of an experimental investigation of the effect of change of temperature on the magnetic moment of magnets of different lengths but of the same cross-section, and on the distribution of the magnetism. The proportional change in magnetic moment due to change in temperature is greater for short than for long magnets; and the magnet having the greater intensity of magnetization suffers the less proportional change. The proportional change in distribution of magnetism due to change of temperature is greatest at the ends and least in the middle of the magnet.—*Am. Jour. Sc.*, March.

Energy of Magnetization.—LARMOR.—Some notes on a recent Royal Society paper in which he points out that there still appears to be some uncertainty as to the principles on which the energy of magnetized iron is to be estimated, and the extent to which that energy is electrodynamically effective. He takes as the simplest example a current flowing in a coil wound on a narrow iron ring-core. The energy in this case is made up of two parts, an electrodynamic part and a magnetic part; the former is mechanically available. The question has been raised by Lord Rayleigh as to whether the latter part has any considerable mechanical effectiveness. This question can only arise when it belongs in part to permanent magnetism whose ultimate annulment can induce a current. The conclusion reached by Rayleigh is that it cannot be annulled quickly enough when the ring carries a coil, to develop any considerable available electric energy by induction. Larmor uses a mechanical analogy to consider this matter in detail and reaches the same conclusion that the retained energy will not be available to any considerable extent unless the iron is not very receptive of magnetization. After an elaborate mathematical investigation, he arrives at the following conclusion: In an electrodynamic field there exists the usual "specification" of electrokinetic energy, but also in addition the energy of magnetization of the magnetic material. This energy of magnetization appears as made up of a part given by the ordinary formula, which, when paramagnetic, is derived from thermal sources, and so in the absence of hysteresis has the limited mechanical availability of thermal energy; together with a local part, which is to some extent thus available, but is also in part permanent intrinsic energy of the molecules, regarded temporarily as magnetic energy. The extent of the direct (non-thermal) availability of retained magnetism can be inferred only by empirical procedure, for example in general features by inspection of the hysteresis cycle.—Lond. *Elec. Rev.*, February 27.

REFERENCE.

Radium in the Periodic System.—RUNGE AND PRECHT.—An account of a spectroscopic investigation of radium.—*Phys. Zeit.*, February 15; abstracted in Lond. *Elec.*, February 27.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Nickel-Iron Battery.—An abstract from an article in *Nya Daylight Allehanda*, a Stockholm newspaper, claiming that the Edison battery was first described by the Swedish chemist, W. Jungner. As early as 1899 Jungner obtained a patent for a battery in which potassium hydroxide is the electrolyte and the plates consist of pow-

dered metallic oxides, which are insoluble in the electrolyte and give a sufficient e.m.f. A few months after May, 1900, trials were made with automobiles, which are said to have given very satisfactory results. "Without exhausting the accumulators below normal voltage, the carriage with load is said to have run nearly 150 kw; the weight of the carriage was 528 kg, that of the battery was 290 kg; at the end of the run the carriage had still a speed of 26.5 km per hour." The nickel-silver peroxide accumulators are, however, too expensive; for this reason Jungner afterwards used nickel oxide and iron, for which combination he obtained a patent on January 21, 1901, while Edison's patent is dated February 5, 1901.—*Zeit. f. Electrochemie,* February 5.

Plates Made of Slabs of Active Material.—LEIMER.—The conclusion of his article, the first part of which was noticed recently in the Digest. 1.5 amp are used for formation of positive plates of 140 × 100 × 6 mm; thick plates are best formed with a nearly constant voltage, which may be 3 to 3.2 volts at the start and about 2.8 volts at the end, and the core of the mass then gets a crystalline and therefore more solid structure. The ampere-hours required for formation are about 35 to 45 per cent. higher than the capacity of the positive plate. For the negative plates the best composition is about 3 parts of minium and 1 part of litharge; they require about twice the time to form. After the formation the negative plates should be kept in pure water and not in air nor in sulphuric acid.—*Centralblatt f. Accum.,* January 15.

Reduction of Potassium Chlorate.—BROCHET.—A brief article on "a so-called electrolytic reduction of potassium chlorate." He agrees with Bancroft and Burrows that in electrolyzing potassium chlorate with a copper anode, potassium chloride is obtained, the quantity of which is greater than should be theoretically expected, but he believes that the theory is entirely different from what might at first be supposed. The products first formed react with one another, and there is an "abnormal" reaction. The reduction of the potassium chlorate is the result of an intermediate action of the metallic copper upon the chlorate.—*Zeit. f. Electrochemie,* February 19.

Static Electricity Applied to Ore Dressing.—SWART.—An illustrated description of a method of Blake and Morscher for a process of ore separation, consisting in bringing a mass of ore particles into contact with a statically charged metallic surface. Particles which have a relatively high conductivity are not repelled, while those of low conductivity are; a machine based on this principle has been working successfully in Denver for some time. A voltage of 10,000 to 20,000 is now used; the static generator is made almost wholly of metal, using no glass whatever, and it is self-exciting and able to run continuously in the open air without regard to atmospheric conditions and with no more attention than an ordinary dynamo receives. The standard machine is a double one, 24 ft. long, 41 in. wide and 81 in. high, using about 1 hp, which includes that for the static charge. The machine is not confined to ores of zinc; all metallic substances, most sulphides and arsenides, and some carbonates and oxides are thrown out of a siliceous or limy gangue, in many instances the extraction being very high; this is particularly true of the sulphides of copper. The advantages of the machine are summed up as follows: Low first cost of the machine and nominal operating expense; it separates materials without regard to their specific gravity, it works well at any mesh between 8 and 200, no roasting of sulphides is necessary, no water is required, no piece of the machine weighs 100 pounds, and any intelligent mill man or mechanic can build a machine and keep it in repair.—*Eng. & Min. Jour.,* January 24.

Electric Manufacture of Steel.—WALSH.—An illustrated article describing the method of manufacturing steel electrically at Kerrouse, France. At these furnaces all kinds of iron ore have been fused and treated successfully by electricity. According to the tests made, it was estimated that to manufacture one ton of steel from ordinary iron ores required the expenditure of 2,800 kw per hour, or about 3,800 electrical horse-power. At the factory in France the cost of electrical energy was estimated at $10 per kilowatt-year of 8,400 hours. Including the cost of electrodes, coke, ore, refining materials, and general expenses, the cost of manufacturing a metric ton of 2,204 English pounds ran from $18 to $20. The coke used, however, cost $8 a ton, and the iron ore likewise cost considerably more than it might be obtained for in this country. On the other hand, the labor item is considerably lower. The working quality of the steel produced has been found to be equal to that produced in the ordinary mills operated by the open-hearth and Bessemer processes. The furnace now building at Kerrouse will consist of one refining furnace, which will do the work of a series of electric blast furnaces. The refining furnace will be portable, running on a heavy truck in front of the series of electric blast furnaces, and will be large enough to accommodate the whole battery of blast furnaces. It is built in the form of a huge ladle, which is inserted in the hole of the refining furnace and the electrodes lowered to begin the refining process. As the ladle is easily and quickly adjustable to any of the furnaces, the process is carried on continuously before the different blast furnaces. —*Am. Elec.,* March.

REFERENCES.

Duesseldorf Exposition.—DANNEEL.—Continuations of his long serial on electrochemical and metallurgical exhibits at the Duesseldorf exposition. He reviews the zinc, lead, copper, silver, nickel and cobalt mines of Germany; exhibits of copper tubes of the Elmore Copper Company are described; also storage batteries and the Goldschmidt thermic process. Heraeus solders aluminum so perfectly that the soldered pieces may be worked with the hammer and may even be rolled into sheets. Exhibits of manganese and manganese alloys (manganin) and platinum are also briefly described.—*Zeit. f. Electrochemie,* January 15, 29; February 5, 12.

Antimony.—IZART.—An article giving a summary of investigations on the electrolytic preparation of antimony.—*L'Ind. Elec.,* January 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

American Meter Practice.—REED.—An article treating of torque and friction in relation to recording wattmeters. The author states that the continued accuracy of any meter depends primarily on preserving permanently the ratio between the torque and the frictional counter-torque. The variable quantity of this ratio is the frictional counter-torque, hence the torque should be so large in proportion that a doubling or trebling of the friction will have no appreciable effect on the accuracy of the meter. In order to get a meter which for all commercial considerations would be correct through all ranges of load, it would be necessary to either increase the torque or reduce the friction; the most economic course is to eliminate the friction, since this cuts down the power consumption of the meter. When the friction equivalent is reduced to its minimum for a given form of construction, the ratio of the friction to the torque at full load for any meter should not be less than the ratio of 1 to 400. This ratio with no friction compensator gives a 2½ per cent. error on 10 per cent. of full load, or 1.2 watts with one light burning on a 5-amp meter. There is an economic limit to the increase of the torque of a meter with a view to obtaining greater accuracy, since when this increase in torque is directly proportional to the current necessary to produce it, the amount of power consumed in obtaining this extreme accuracy is greater than the amount of power lost through inaccuracy.—*Am. Elec.,* March.

Vibration Magnetometer.—SEARLE.—A description of a new form of vibration magnetometer which obviates the difficulty of the ordinary forms when used in a non-uniform field. The magnet is a cylinder 1.50 cm in length and 0.14 cm in diameter, of the "silver steel" used for making small tools, the steel being rendered "glass-hard" by quenching at a bright red heat. The magnet is magnetized between the pole-pieces of a small electromagnet and its magnetic moment is about 3 c.g.s. units. In order to make a great increase in the time of vibration, the magnet is attached to a brass plumb bob. The main part of the bob is 1.6 cm in length and 0.8 cm. in diameter, the total mass of the system being about 8.5 grammes. The lower part of the bob is turned down to a smaller diameter, and into this part are fitted the magnet and a pointer of aluminum wire 5 cm in length; the lower end terminates in a sharp point. The upper end of the bob is fitted with a small eye, made by soldering a loop of fine wire into a small hole drilled along the axis of the bob; to this eye the suspending fibre is attached. The change of magnetic moment due to the earth's horizontal magnetic force is only 0.2 per cent. The author also proposes to revive the ball-ended magnets described by Robinson in 1801. They can be made by mounting bicycle balls at the ends of knitting needles and magnetizing them between steel plugs, fitting the balls at the ends. Such magnets behave very nearly like ideal magnets having their poles in the centers of the balls. Cavendish's law of inverse squares may be demonstrated with some accuracy by the aid of such magnets.—*Proc. Cambridge Phil. Soc.,* V. XII, pt. I, 1902; abstracted in Lond. *Elec.,* February 27.

REFERENCE.

Integrating Wattmeter Connections.—WEEKS.—An illustrated article showing how to connect a wattmeter in circuit while the motor is in operation, and also explaining the calculations necessary to obtain the work done from the meter readings.—*Am. Elec.,* March.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Recording Telegraph.—HOPKINS.—An illustrated article on recording telegraph apparatus for amateurs.—*Sc. Am.,* February 21.

Telephone Engineering.—DOMMERQUE.—An illustrated article on the treatment of poles. The author describes several processes of treating poles with preservatives. The method followed by the German Post Office Bureau is given as a typical example of the sulphate of copper process. A description is also given of a similar process used in France, and of the creosoting process used in this country.—*Am. Elec.,* March.

A Modern Private Branch Telephone Exchange.—O'BRIEN.—An illustrated article describing the methods of operation and wiring, and to some extent the construction, of one of the most common types of private branch switchboards, and giving detailed instructions for the installation and maintenance of such systems.—*Am. Elec.,* March.

New Books.

TECNOLOGIA DEL CALORE. By Rinaldo Ferrini. Milan: Ulrico Hoepli. 268 pages, 58 illustrations. Price, 6.5 lire.

A literal translation of the title of this book would be "Technology of Heat." The volume is divided in five chapters or parts, respectively entitled Combustion, The Apparatus for Combustion, The Transmission of Heat, The Effect upon the Surrounding Medium, and Ventilation.

Chapter I, on Combustion, deals entirely with the theoretical chemical reactions of the various combustibles, and particularly describes the various forms of calorimeters and the methods employed in determining specific heats. Chapter II is occupied with the practical apparatus for burning combustibles, such as boilers, furnaces, etc. In Chapter III the absorption of the heat produced by the tubes of boilers, and by other things with which heating apparatus is surrounded, is described. Chapter IV deals with the methods used in the artificial heating of buildings. Chapter V exhibits the principles of ventilating both for public and private buildings. The work is somewhat mathematical in character and abounds in very complete tabular data of various kinds.

ASYNCHRONE GENERATOREN. Fur ein und Mehrphasige Wechselströme. By Clarence Feldmann. Berlin: Julius Springer. 134 pages, 50 illustrations. Price, 3 marks.

This is a treatise on asynchronous dynamo machinery, and though the title page claims a description of alternating-current generators, both in theory and practice, there is little to be found in the work excepting an exhibition of the mathematical theory. There are three chapters. The first chapter deals with the analytical methods which are applied to the calculations of multifarious generators and motors. The second chapter takes up the subject from the graphical standpoint, and gives diagrams, whereby the problems which in the previous chapter were solved analytically, are treated graphically. In the last chapter single-phase machines are discussed and are treated in a similar manner, both analytically and graphically. For those enjoying mathematical analysis as applied to dynamo machine construction, the work will be of interest and value, but its mathematics will doubtless be found formidable by the average engineer.

THE ELEMENTS OF ELECTRICAL ENGINEERING. A First Year's Course for Students. By Thomas Sewell, A.I.E.E. New York: D. Van Nostrand. 332 pages, 204 illustrations. Price, $3.00.

This volume embodies a series of lectures delivered to classes of students in electrical engineering, whose course was of the grade and character of those usually taught to evening classes at manual training schools. But little mathematical knowledge is demanded for its reading; and the text, which is largely descriptive, puts all numerical relations in the simplest possible manner. The class of readers to which the book will appeal are those who pursue a correspondence course, or attend an evening school; and the general reader who desires information on electrical subjects of a semi-technical descriptive character. There is evidently a demand for books of this nature, judging from the number published; and when they are intelligibly written they are of service to the general reader and of assistance to the professional engineer. The author who designs such a work needs not only a knowledge of the subject, but discrimination and judgment in presenting facts and principles, which come only from maturity and wide experience. The contents of the present book do not indicate that the author possesses these qualifications.

The author devotes the early chapters in this book to the conception of electrical resistance and the principles of the electrical circuit. In doing this he has resorted to an elaborate hydraulic analogy of the usual kind. This being well enough in its way for mere illustration, becomes poor pedagogy when strong emphasis is placed upon it. The reader's attention in such a case is more apt to be taken up with the illustrations than the electrical facts presented. In short, when an illustration requires more attention to follow it than the primary fact, it becomes inefficient and cumbersome. Judging from the insistence upon the hydraulic analogy, one would suppose the author was lecturing to a class of plumbers. The chances are that the general reader knows little of plumbing, and has in this book to master two dissimilar facts instead of one. The principles of Ohm's law, electrical resistance and circuits, and such subjects are intellectually so simple and easy of comprehension when intelligibly presented, that there is no need of illustration and analogy. These chapters in contrast with the method pursued by Prof. Atkinson in Chapter III of "Electrical and Magnetic Calculations," present the contrast of an obscure and cumbersome method with a direct, clear and intelligent one.

The style of the book is that of the oral lecture and makes its contents easy and pleasant reading. This feature is commendable and an agreeable change from the abrupt topical condensation of facts that characterizes the usual text-book. One cheerfully puts up with the increased bulk and cost of a book when it is written in a natural and pleasing style.

The chapter on the magnetization of iron is clearly and adequately written for a work of this scope. It is illustrated with frequent numerical calculations and accompanied with excellent diagrams. One is rather surprised, however, at the conservatism which avoids all reference to the names of the magnetic units. The caption of a following chapter is "Indicating Instruments—Ammeters, etc." The author here is confused as to the distinction between an indicating and a measuring instrument, for in the opening sentence he speaks of the ammeter as an instrument for measuring current. The Weston instrument comes in for a long discussion, and as a matter of course the Kelvin electrostatic switchboard voltmeter is described and illustrated, with its plumb bob and other accessories. In the following chapter, galvanometer and the resistance box are considered.

The arc lamp is well discussed from the point of English practice, though perhaps too little attention is given to the enclosed arc. As in other parts of the book, the author here avoids a reference to the alternating current, and so contracts his subject within too narrow limits. Unless this work is to be followed by a second one in which alternating current practice is discussed, the exclusion of all such reference from the present volume reduces its importance to the older lines of electrical engineering, and puts it out of touch with the advancement of the last ten years. The manufacture of the incandescent lamp is fairly well described, and its photometry in a meagre way. However, when describing the exhaustion of the lamp, no reference is made to other than the Sprengel pump. This is singular, for the Geryx mechanical pump is made in England and should be known to the author, and as well its employment in connection with chemical exhaustion.

The book concludes with the chapters on the continuous-current dynamo and the direct-current motor. The first is discussed in a conventional and elementary manner, and the second inadequately. As a book purporting to cover the elements of electrical engineering, one would expect to find in it some mention of separate driving, and many such applications to electrical practice.

This book is commendable from the manner in which the author confines himself to the presentation of the elements and principles of electrical engineering, and avoids purely descriptive and catalogue matter. The author, however, is again at fault when he makes but few references to formal and periodical literature; and the book from this defect will lack stimulation and suggestion for the reader.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY, Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

AMERICAN STREET RAILWAY ASSOCIATION, Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

IOWA TELEPHONE ASSOCIATION, Secretary, C. C. Deering, Des Moines, Iowa.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 26, 27 and 28, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

A Notable Invention in Rapid Telegraphy.

BY ROMYN HITCHCOCK.

Mr. Patrick B. Delany, who is so well known for his many inventions in telegraphy, particularly for the Delany multiplex and for improvements in automatic methods, has recently been granted a patent (No. 72,004, issued February 10, 1903), for a method of utilizing the so-called static charge of a telegraph line in telegraphy, whereby signals may be transmitted and sharply recorded in Morse characters at the highest possible speed. Hitherto the retardation of the line has interfered with rapid operation, and even in ordinary hand working of duplex and quadruplex apparatus special devices are necessary to overcome static effects. In the more rapid operation of machine telegraphy, when signals must be recorded on chemical tape at speeds in practice of 250 or 300 marking impulses per second, with experimental speeds achieved of 2,000 or more, the static charge has always been troublesome.

It is obvious that if this disturbing charge is a noticeable impediment to fast working with the chemical recorder, where the line current passes directly to the chemical tape without intervening mechanism, it must impose much greater restrictions upon any system which requires the current to actuate armatures or mechanism, however light or delicate it may be. Moreover, when the successive impulses are of different duration, as when dots and dashes are sent for Morse characters, the static charge is not the same for all signals, being larger for the longer impulses. Under such conditions if we attempt to cut off the trailing of the dashes, which is caused by the discharge of the line, with a current of reverse polarity, that current may give rise to a discharge which will also weaken or obliterate a succeeding signal.

The only way to maintain the line conditions constant, or to exercise effective control of them, is to make the signals all of uniform duration. Having accomplished this, the best theoretical conditions of transmission would then be attained by successive reversals of polarity. Both these results have been practically achieved by Mr. Delany, and the patent above referred to shows a most admirable adaptation of alternating impulses of equal duration, to the production of perfect dots and dashes at the receiving end of a line, of whatever length.

It will be recalled that some years ago Mr. Delany produced a perforated tape by means of which all impulses in Morse transmission were made of equal length. They were also recorded on the receiving tape in marks of uniform length. The signals representing dots in the Morse code were sent with the positive current to line, while the dash signals were sent with the positive to earth. By an arrangement of three parallel iron needles, set close together, their points in line across the tape at the receiver, the positive line current passed to the tape through the middle point and made its mark by electrolytic action. The positive current sent through the earth made a double mark through the two outer needles. The single marks represented dots, the double marks represented dashes. The records thus made were easy to read. There could never be uncertainty in distinguishing dots and dashes. Under unfavorable line conditions the static charge would cause the marks to tail out and perhaps run together, but even under the most extreme conditions of tailing, the length of the lines thus merged together would enable the reader to instantly know the number of single marks composing them. In this method the reversals of polarity were irregular, depending upon the succession of dots and dashes in the letters sent. This represented the most advanced condition of commercially practicable machine telegraphy until quite recently, and it was capable of making legible records at a speed of several thousand words a minute.

The next forward step was to introduce reversals of current for every impulse, and to use a single marking pen for the production of dots and dashes on the chemical tape. The problem was to cause impulses, all of the same duration, to be recorded in a single line as dots and dashes. This is accomplished by allowing the static charge to continue or prolong a mark started by a short impulse sent into the line. Dots or dashes are made by cutting off the mark at the proper instant by the reverse current. The time allowed between the primary impulse and the impulse of opposite polarity, determines whether the record shall be a dot or a dash.

Thus, what has hitherto ben the most serious obstacle to rapid telegraphy becomes a most important adjunct for successful operation at speeds approaching the theoretical limit. If the line has not sufficient capacity, a condenser at the transmitting station supplies the deficiency.

The method of operating is simple. Each signal, whether a dot or a dash, is made with two impulses of opposite polarity and of equal duration. These are sent to line by means of a perforated tape. The tape is prepared by operating a Morse key in the usual manner of line working. When the key is pressed down a hole is punched near the lower edge of the tape; when it comes up a hole is made near the upper edge. The tape is constantly running, and thus the holes, being made in succession, bear a slanting relation to each other on the tape. The time of holding down the key determines the angle of slant. For a dot they are nearly in a vertical line, only sufficiently inclined not to overlap; for a dash the angle of slant is larger.

As the tape runs through the transmitting apparatus, electrical contacts are made through the holes by means of metal conductors or "brushes." The two brushes beneath the tape are connected respectively with the positive and negative transmitting currents, and the opposing brushes above are connected to the line. Through the holes along the lower edge of the tape positive impulses are sent, and through the other row of holes negative impulses.

At the receiver the line currents pass to the chemical tape through an iron marking point and thence to ground. The positive current alone marks the tape by electrolytic action—the negative current having no such effect. If a positive current is sent and a negative follows immediately, the mark is cut short, making a dot; if a longer time intervenes the mark is extended by the static discharge beyond the duration of the current.

There are a number of claims in this interesting patent, but the broad scope of the invention may be indicated by the wording of the first claim, which is as follows:

"In a telegraph system in which each signal is composed of two impulses of opposite polarity sent into a circuit at a transmitting station, the method of transmission and recording which consists in adjusting the capacity or consequent retardation effect of the circuit so that the formation of a record character will be continued after its primary impulse is sent into the circuit, sending the primary impulse of a signal into the circuit to initiate the production of a record thereof, disconnecting the generator from the circuit and permitting the "capacity" effects of the circuit to continue the production of said character, and terminating the formation of the character by transmitting the secondary impulse of opposite polarity."

"Sparklet" Fuses.

Elliott Brothers, London, are introducing an ingenious fuse, the invention of Mr. G. W. Partridge, chief engineer of the London Electrical Supply Corporation, which employs sparklets in its operation. These sparklets, as our readers are doubtless aware, are small steel bottles, about as large as an olive, containing liquid carbonic acid gas; the necks are closed with thin steel stoppers, made gastight for a pressure of 600 lbs. per sq. in., with a thin rubber ring. Sparklets are commonly used for the purpose of aerating water in "siphons," a simple attachment to the latter enabling the user to pierce the stopper of the sparklet, so as to release the gas. They are readily obtained in boxes of 12 from chemists, etc., and are inexpensive. The sudden expansion of the carbon dioxide as it flashes into gas, produces a temperature in the neighborhood of 100° F. below zero; the gas itself, by its incombustible nature, tends to extinguish flame, and at the same time the violence with which it is ejected from the sparklet, as though the latter were a small cannon, acts as a blow-out device of the highest efficiency.

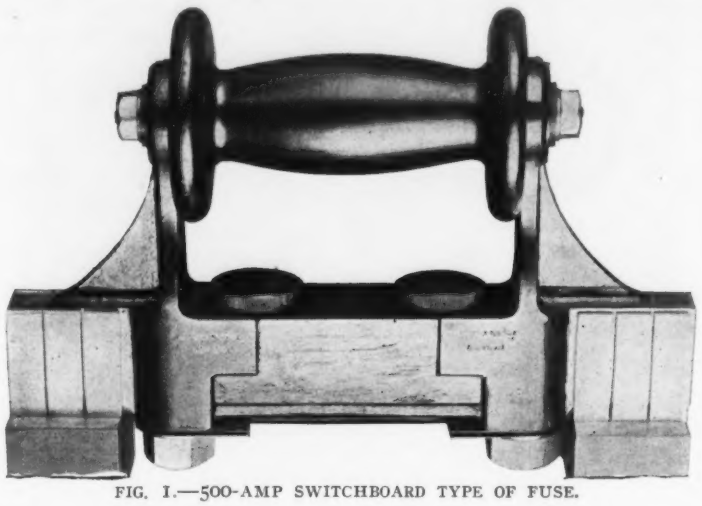


FIG. 1.—500-AMP SWITCHBOARD TYPE OF FUSE.

The construction of the actual fuses, which have now been in use by the L. E. S. Corporation for two years, is quite simple. The type of fuse illustrated is that which is intended for the high-pressure side of transformers; the body is a trough of earthenware, with a recess at each end, near the terminals. The fuse consists of a suitable number of fine copper wires, which are enclosed between strips of mica for the greater part of their length, but are exposed near the ends. The fuses are made up with metal terminal plates, ready for immediate insertion into the trough. Two marble blocks fit into the recesses in the earthenware referred to above; in each of these there is a hole shaped in such a way as to receive the body of a sparklet, while allowing its neck to project slightly beyond the surface at the side next to the fuse-gap. When these blocks are slipped into place, the sparklets are held in postilon by spring clamps projecting from the terminals of the fuse, so as to ensure their connection with the circuit—an essential feature.

It will readily be understood that directly the fuse has blown, the arc which follows rises, passes on to the end of one or both of the sparklets, fuses the stopper and releases the gas, which extinguishes the arc. The fuse operates equally well whether blown by a short circuit or by a long-sustained excess of load; the latter condition is regarded by the inventor as an especially severe test, the arc formed under these conditions being peculiarly persistent. The length of gap required to deal with an arc at 10,000 volts is only 9 in., as compared with the 4 ft. 6 in. fuses which have been used; two sparklets are used, one at each end, but this is only for additional security, as one always suffices.

The sparklets may be applied to switches which have to operate under heavy loads, and are quite applicable to 500-volt circuits. Mr. Partridge has, in fact, employed them in this way, the sparklet being so placed that the arc formed on opening the switch opens the sparklet. When the system is applied to circuit-breakers, a magazine of the revolver type is employed, by means of which a fresh sparklet is brought into position every time the switch is closed. We understand that not one defective sparklet has yet been met with.

The fuses for low-tension work are made in several standard sizes for currents up to 1,000 amp, and pressures up to 500 volts continuous current.

Fig. 1 illustrates a 500-amp switchboard type of fuse, which consists of two gun metal castings separated by a block of insulating material and handle. The castings form the contact blades, sparklet holders and fuse contacts; the sparklets, held in position by the insulated screw caps, project through the insulating block so as to be in the path of the arc, which, by piercing the ends of same, liberates the compressed gas which extinguishes the arc.

Fig. 2 illustrates a type of high-tension fuse suitable for 500 amp at 2,000 volts. It consists of a substantial porcelain tube with metal caps cemented on the ends, each of which hold three sparklets projecting into the tube through bushed holes; the fuse wires are sweated to copper lugs and are bolted to the contacts in the usual manner. Fuses for pressures up to 10,000 volts are made similar to this, but with a group of sparklet held in a spider and fixed in the bottom of the tube, and so arranged that the liberated compressed gas blows along the path of the arc.

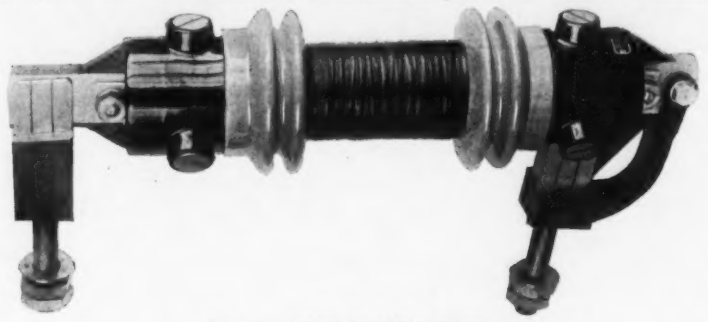


FIG. 2.—HIGH-TENSION FUSE.

Fig. 3 shows a sparklet fuse for use in sub-stations, etc. This is for currents up to 50 amp and pressures up to 5,000 volts. The sparklets, fuse wire, etc., are carried upon a porcelain handle which slips into a porcelain box supported on insulators fixed to a base. Several modifications of this type are made for house service fuses, instruments, etc. All sparklet fuses are made of the "Switch" or "Plug" type, and can safely be handled whilst alive, and removed for renewing fuses or for examination, without the use of insulated gloves or tongs.

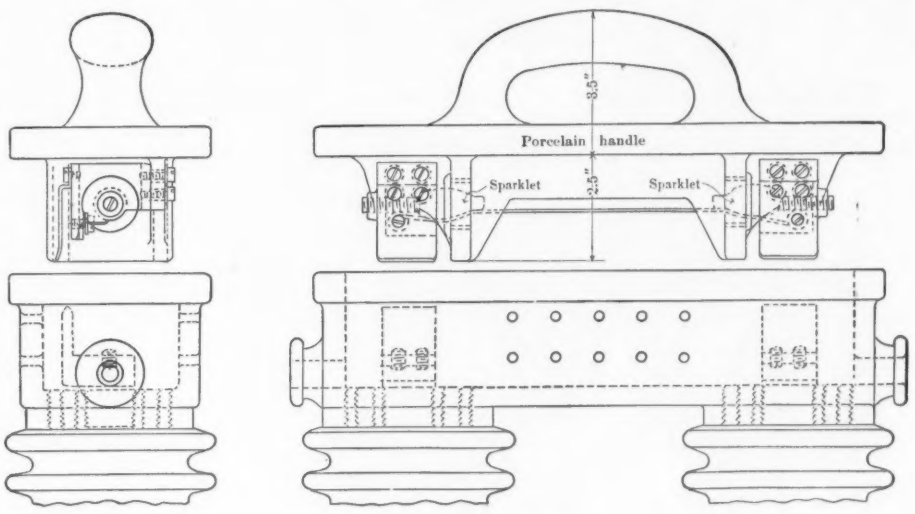


FIG. 3.—FUSE FOR SUB-STATIONS.

Interruptions of the California Long Distance Power Service.

The Bay Counties Power Company's 140-mile transmission line, from Colgate to Oakland, Cal., was shut down for about 30 hours, following a switchboard fire, which occurred on March 4 in the Colgate Power Station. The Stanley generators were well adapted

to withstand water, but they had to be carefully tested out after the wetting they received at the time of the fire. The company's engineers under Superinendent L. M. Hancock made a record for quick repairs and the system was in operation up to its full capacity of seven generators within four days. The California Gas & Electric Corporation has three other plants which combined have two-thirds of the capacity of the one at Colgate and so the valley and mountain power lines suffered no interruption of service.

Within 90 days a large electric power plant at Nimshew will be in operation, and in case of any future trouble at Colgate the new station will be able to supply the bay lines. The 2,000-hp electric railway power house of the North Shore Railway Company, at Alto, Cal., which will be completed by May 1, will also be used as a steam reserve station in case of trouble on these lines.

The cause of the switchboard fire at Colgate is not fully understood, though there was a short circuit on the line at the Cordelia switching station just preceding the trouble. There are circumstances which would tend to support the theory that the plant was struck by lightning.

The Standard Electric Company's transmission system, extending from Electra to San Francisco, resumed operations on March 5 after a shut-down of some days as a result of landslides on its hydraulic system in the Sierras. The company will greatly increase its water storage facilities this year. It was an unfortunate coincidence, which will probably never occur again, that the Standard Electric Company's plant was shut down at the time that the Bay Counties Power Company's service was interrupted, as the two plants are so connected as to be able to help each other out in case of trouble.

The Felt Axle-Driven Train Lighting System.

The system of axle train lighting, designed by Mr. Charles E. Felt, of Chicago, which was mentioned in the discussion on train lighting at the Chicago meeting of the American Institute of Electrical Engineers, is here illustrated. Fig. 1 shows the apparatus as applied to the truck, and Fig. 2 is a drawing of the details of the driving mechanism. The system is one in which the dynamo is driven at constant speed as long as the train exceeds a certain predetermined speed. The dynamo always revolves in the same direction. The driving mechanism consists of a disc either mounted directly on the car axle or geared thereto. Bearing against each side of this disc and driven by friction from it are two pulleys as seen in Fig. 2. These friction pulleys bear against the disc with sufficient pressure to transmit power to the generator. The pulleys are loose on their journals and are provided with ratchets and pawls, so that when the train is going in one direction, one of the pulleys

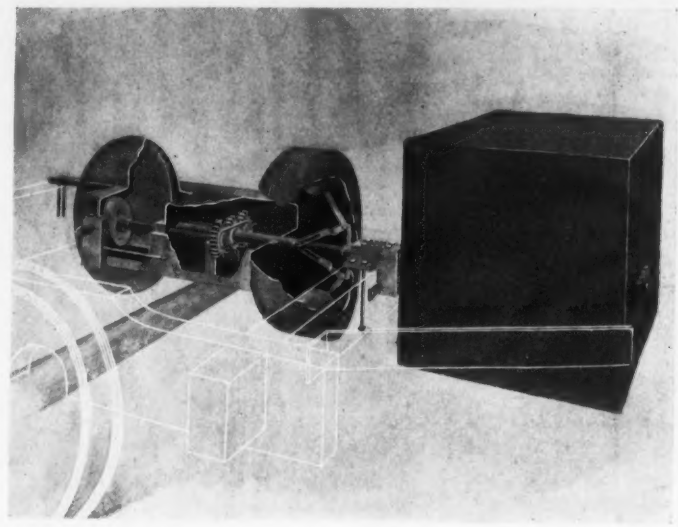


FIG. 1.—APPARATUS APPLIED TO TRUCK.

revolves free without turning the journal on which it is placed, while the pawl on the other engages its ratchet and drives its axle. With the train going in the other direction, the condition of affairs is reversed; that is, the pulley on the opposite side of the disc does the driving and the other pulley revolves free. Power from the friction pulleys through the dynamo shaft is transmitted through spur gearing as seen. The regulation of the dynamo speed is accomplished by an ordinary ball governor. When the speed is slow, this governor allows the friction pulleys to remain near the periphery of the driving disc. As the train increases in speed, this governor moves the friction pulleys nearer the center of the disc. In this way the dynamo speed is kept nearly constant through a large range of train speed. The system is an exceedingly simple one electrically.

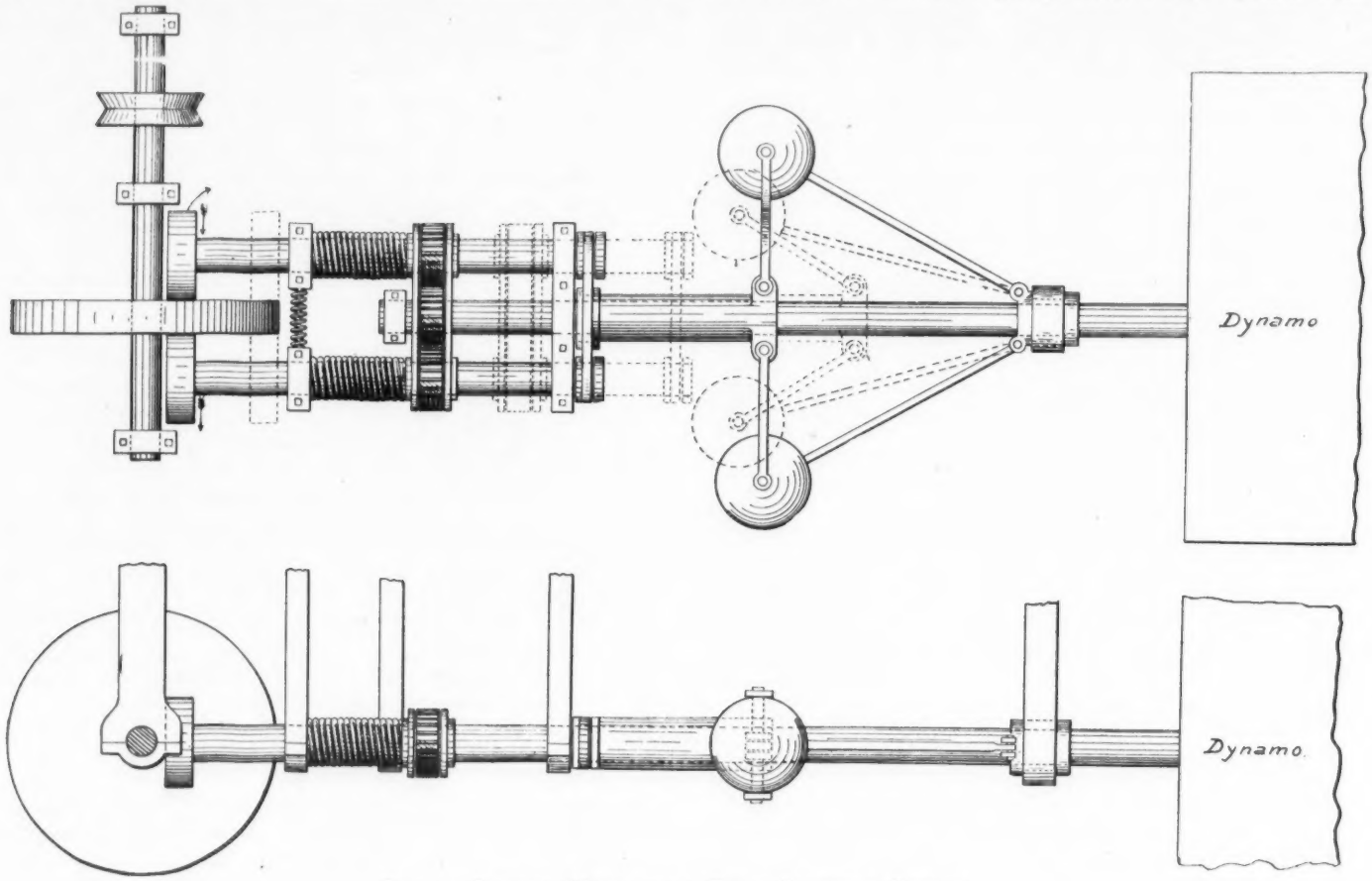
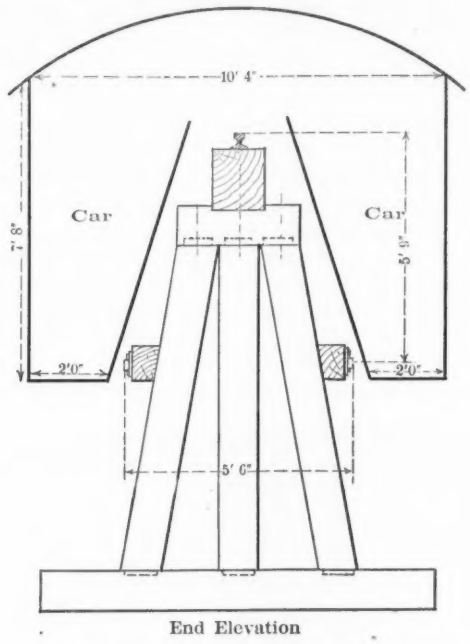


FIG. 2.—DRIVING MECHANISM TRAIN-LIGHTING SYSTEM.

As the dynamos are always revolving in one direction, no automatic reversing switches are required. All the switching necessary is to cut out the dynamo when the train is going at a sufficient speed to generate, and to cut the dynamo into circuit when the proper speed is reached. This is done mechanically by the action of the ball governor, so there is practically no automatic electric controlling apparatus. The driving is of course done entirely by the friction of the pulleys against the disc. This requires considerable pressure between the disc and pulleys, in order to transmit the power without slipping. However, this does not involve end thrust of any kind, because the pressure of the disc is equal on both sides, as the friction pulleys bear on both sides and tension is maintained simply by the spring drawing them together. All the bearing friction is, therefore, taken on ordinary journal bearings, which are not subject to the great friction losses of thrust bearings. Mr. Felt was formerly a mechanical engineer with the Pullman Company, and has had, therefore, much experience with various axle-driven train lighting systems. He has been impressed with the complication involved in many of them and believes that the present system on account of its simplicity will eliminate many of the common difficulties.

Monorail Railway.

The monorail railway system to which the accompanying cut refers has been devised by Frank Moberly, of Victoria, B. C., for the purpose of meeting conditions presented in the mining districts of British Columbia and similar districts elsewhere. In the province mentioned there are many large ore deposits unworked for want of cheap transportation, most of them being so situated that they cannot be reached by the ordinary railroad or tram. Mr. Moberly believes that a system of monorailroads operated by electricity would be a solution of the cheap transportation problem, and that proposed is a modification of what is known as the Lartique system. A road of this design has been in operation for some sixteen years between Ballybanion and Listowel, in Ireland, with satisfactory results, the operating power, however, being steam.



CROSS-SECTION MONORAIL RAILWAY.

The sketch will give a general idea of the mode of construction proposed. The cars to be used will vary with the requirements of each locality and can be utilized for the carriage of passengers, ore or general freight. The motive power will be electricity, which can be generated anywhere by water power, of which there is abundance waiting to be developed; and besides operating the railway, power can be supplied to mines or other industrial enterprises that may require it. In the majority of cases the power can be developed at or near the initial point of these railroads, thus greatly facilitating construction work.

The main features claimed for this system of railway is the cheapness of construction, maintenance and operation as compared with the ordinary railway, and also the possibility of avoiding obstruction by snow—a great feature in mountain work. All heavy grading and other costly work incidental to railway building in a mountainous country will be avoided.

General Electric Motor for New York Subway.

The accompanying cuts illustrate the type of motor which will be supplied by the General Electric Company for the equipment of the cars of the New York Subway. There will be 340 motors of this type used, and the same number of Westinghouse motors.

There will be two motors on each car of an aggregate capacity of 400 hp. The weight of each motor is 6,000 pounds, and it is adapted for mounting on a truck with 50 in. between wheel hubs. It is fitted with the nose suspension and its front side is supported by lugs cast on a frame. This lug is designed to rest on a bracket riveted to the truck transom with a forged strip bolted over the top of the lug to prevent the motor from rising. The motor is mounted on or removed from the truck from above, when the truck is out from under the car, no pit being required.

The magnet frame is unsplit, and is made of one piece of cast-steel, substantially in the form of a cube with well-rounded corners and large bored openings, one at each end, into which frame heads carrying the armature shaft bearings are bolted. Through these openings the armature is put in place or removed from the frame.

The pole pieces are laminated and are bolted to the interior, top, bottom and sides of the frame with through bolts with nuts on the outside of the frame.

The field coils are wound with flat copper ribbon in a common plane. The coils are insulated with mica and a specially prepared fabric which makes them semi-fireproof and practically impervious to moisture. The air-gap is a total of 7-16 in., 3-16 of an inch above and 4-16 of an inch below the armature.

The armature has a series drum barrel winding. Its conductors are copper bars, separately insulated and assembled in sets of five, the set as a whole having an outside protective insulation. The bars are soldered directly into ears. forming a part of the commutator segments, thus avoiding entirely the use of connecting leads. At the back of the armature the top and bottom bars are connected together with tinned clips riveted and soldered but easily removable in case it should be desired to replace top bars without disturbing the bottom bars. The conductors are held in slots by tinned steel wire bands imbedded in the core beneath the periphery, the wires being soldered together and held by tinned clips. The armature core is of the "iron-clad" type, and is made up of soft iron laminæ.

The commutator segments are made of hard-drawn copper insulated throughout with the very best grade of mica. The commutator shell and cap are made of cast-steel, the parts being especially

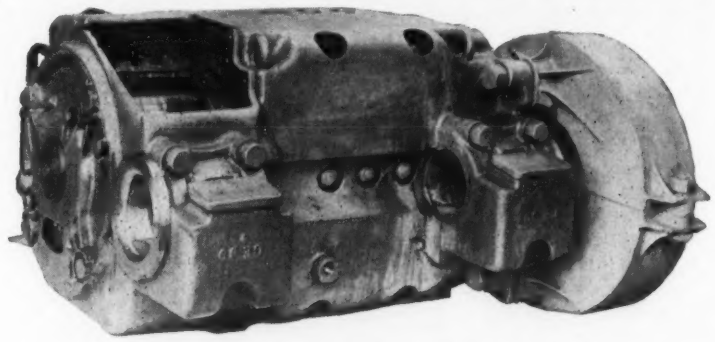


FIG. I.—AXLE END OF MOTOR.

strong; the segments are clamped very tight, the cap being pressed home in a hydraulic press previous to tightening the commutator bolts. The commutator ears, into which the armature conductors are soldered, are formed integral with the segments so that there is no joint between the ears and segments, thus making a thoroughly insulated, strong and compact construction.

The brush holders are made of cast bronze, and are adjustable to allow for wear of the commutator. The heads carrying the armature shaft bearings are each made of malleable iron cast in one piece. In order to secure large and long bearings without sacrificing other desirable features of construction, the heads in a cone shape are extended well under the commutator shell and pinion and armature

core head. This construction forms a support for the bearing lining, which is very strong and rigid.

The armature bearing of the motor bearing is open to lubrication only on the side opposite the shaft pressure. The babbitt lining is

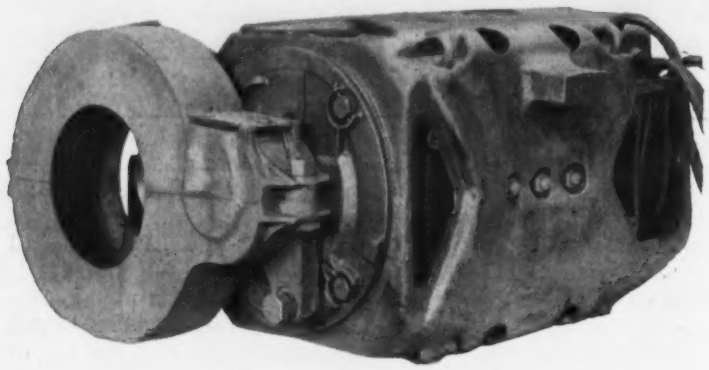


FIG. 2.—SIDE VIEW OF MOTOR.

only 1-16 in. thick, preventing the armature dropping more than this distance even in case of hot bearings melting out the babbitt. The bearing is soldered into a shell of the best quality bearing bronze by first tinning the inside of the shell before pouring in the babbitt.

The gears are made of a superior grade of cast steel and the

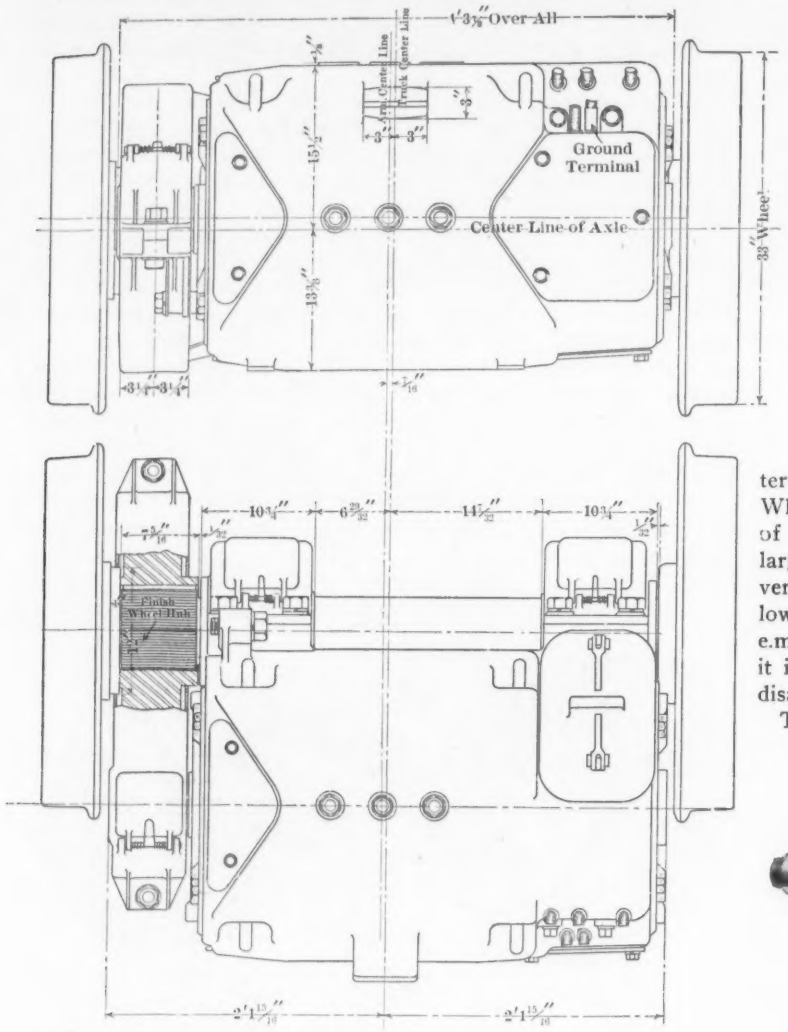


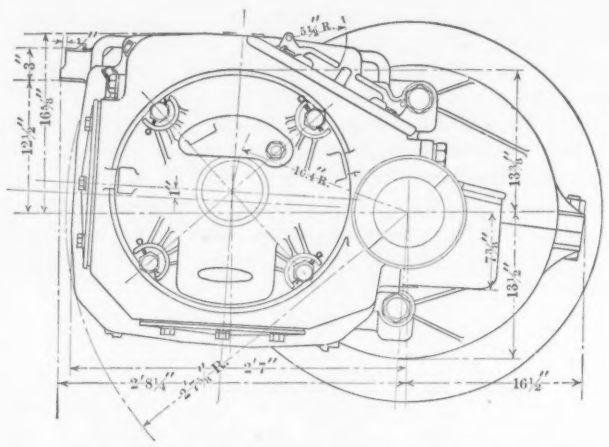
FIG. 3.—PLAN AND ELEVATIONS OF MOTOR.

pinions are forged steel, extra hammered to improve the quality of the metal. This material has an elastic limit of not less than 38,000 lbs., and a tensile strength of about twice that amount. The gears have a 5¼-in. face and are cut with 2½-in. diametrical pitch. The pinion has a taper fit on the armature shaft of ⅝ in. to the foot, measured radially.

The gear case is of substantial construction and is bolted directly to the frame of the motor without the use of lugs. This form of construction was introduced by the General Electric Company for the first time on the Manhattan Railway, and has given very good satisfaction, as it avoids all possibility of the breaking of lugs. The gear case is of malleable iron, and radiating from the three points at which it is attached to the motor frame are strengthening ribs to prevent the case from cracking when subjected to the excessixe vibration received in service. Both top and bottom halves of the case are bolted to the motor frame and the two halves are bolted together.

Another very important feature of this motor is the method which has been adopted to overcome the trouble popularly known as "flashing over." It might be said that this is a subject to which the engineers of the General Electric Company have given a great deal of attention in the past, first to determine the cause of the "flashing over," and second to cure the trouble. A large number of tests have been made at the Schenectady shops, and those which have been carried out on this particular motor indicate that the correct solution for the problem of cause has been discovered as well as its proper remedy.

Properly to understand the improvement adopted it is necessary to understand the reasons for the flashing. This trouble occurs almost entirely when the motors are running at high speed, when the line voltage is high, or say above 575 volts, and immediately after there has been a momentary interruption of the power circuit with full current on. This interruption may be due to a variety of causes, as, for instance, a break in the third rail, a high joint, which causes the contact-shoe to jump, or in some cases from sleet or ice on the rail. Assuming that there has been a momentary interruption in the circuit, the magnetization of the field disappears. When, then, there is a restoration of the current on the completion of the circuit after contact is again secured, there is momentarily a large rush of current through the motor, due to the fact that for a very short interval of time, the self-induction of the motor being low, there is no field on which the armature can build up a counter e.m.f. This interval is measured in hundredths of a second, but it is long enough so that the excess current is liable to produce a disastrous effect on the motor.



The method of obviating the trouble, as applied on the subway

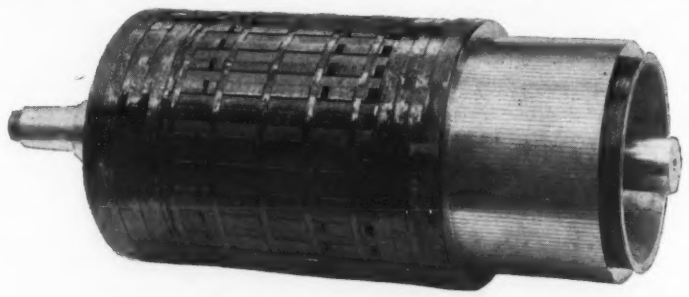


FIG. 4.—ARMATURE OF MOTOR.

motors, is comparatively simple. As is well known, it has been the practice of the principal manufacturers heretofore to place around the field poles of the motor short-circuited copper bands for the purpose of steadying the motor, and also, though not of the first importance, to reduce the arcing at the controller. With the type of control used, the contact resistances are of such a character as to possess ample margin to take care off any self-induction, however great. The use of these copper bands is, therefore, unnecessary so far as the controller is concerned. They have, therefore, been omitted. and where the field winding is supported by or surrounded by a metal

shell for mechanical support, that metal shell is cut or open-circuited so as to prevent its acting as a short-circuiting conducting band around the poles. In other words, the effect has been to make the self-induction of the motor sufficiently great to prevent a sudden inrush of heavy current in case of the momentary interruption of the power circuit.

Electrical Contracts in the Philippines.

A cablegram has been received by the War Department at Washington, from Governor Taft, to the effect that the Municipal Board of Manila, the Advisory Board and the Philippine Commission, acting jointly, have accepted the bid of Charles M. Swift, of Detroit, for railway and electric light and power franchises in the city of Manila. First-class fares are to be 6 cents, 100 tickets for $5.50. Second-class fares 5 cents, six tickets for 24 cents. Mr. Swift represents a syndicate comprising himself, J. G. White & Co., engineers and contractors, of New York, Frank H. Buhl and P. H. Kimberly, of Sharon, Pa., and George C. Smith, of Pittsburg, representing the Westinghouse interests. The above syndicate will immediately form a company to take over this concession, which covers the building of 35 miles of electric railway in Manila and its suburbs, and the building and operation of electric light, heat and power plants.

The above syndicate has also contracted to purchase the old Manila tramways and will thereby have control of all the tramway business in the city of Manila which has a population of something over 300,000. J. G. White & Co. will have the entire construction of both the railway and lighting plants, as well as the track construction, overhead trolley system, etc., etc. The Westinghouse companies will furnish the apparatus.

It is stated that the Philippine Commission is very much gratified with the entire transaction, regarding it as the beginning of a new epoch in the Philippines in the investment of large American capital, and also feels convinced that the franchise granted by them to the syndicate will be both beneficial to the people in Manila and also to the investors. The engineering plans for the construction are now under way and engineers will start in the near future for Manila to begin their work, so that no delay will occur. It is probable that the greater part of the material used will be shipped from America at an early date.

New Electric Automobiles.

One of the notable exhibits at the recent Chicago auto show was the combination surrey and tonneau of the Kammann Manufacturing Company, designed by and built under the patents of William T. Kammann, engineer to the company. The machine comprises many interesting features, among which may be mentioned the steering heads at the center of the front hubs, first used by Mr. Kammann seven years ago, and the double-acting, self-tightening internal band-brake in the hubs of the rear wheels. The strain of braking comes on a stop integral with the axle and does not come at all on the operator.

The frame is of steel angle iron and T-iron, braced and rivetted like a bridge truss and is very light and strong. The four springs extending radially from the steel frame to the ends of the axles very close to the hubs of the wheels permit of the use of a very light and tubular axle, without trussing, and also give support to the body at such a distance from the center of gravity as to make the body very steady. The battery (88-95-amp-hour cells) rests in groups on T-iron channels rivetted to the main frame angle. The battery is open to the air at the bottom as well as at the sides and top. Pneumatic cushions on all the seats make riding luxurious without pneumatic tires.

The motor is the Kammann bipolar type, with a very short magnetic circuit of large cross-section, and is suspended from the body frame by means of two fore-and-aft trunniars. As the trunniars are longer than their bearings, and as the bearings are oblong horizontally, the motor can adjust itself to all conditions of chain length and body inclination.

As the body has a possible vertical range of motion of nearly five inches, and as the outboard motor bearings supporting the small sprockets are mounted integrally with the steel casting supporting the wheel bearings, provision is made for keeping these small sprocket bearings in line with the motor by making the arms on which the sprocket bearings are mounted of such a length that their vertical angular movement due to the varying angularity of the springs supporting the body just compensates for the vertical movement of the body. The trunnions take care of any fore-and-aft or oblique movement. The four motor bearings (two on the motor and two at the small sprockets) are, therefore, kept in line and free from binding without the aid of universal joints in the motor shaft.

The differential gear is bevel and is on a hollow motor shaft. The motor has roller bearings. The machine is all metal, not an ounce of wood being used in its construction. The body is aluminum with

FIG. 1.—COMBINATION SURREY AND TONNEAU.

frosted finish, wheels and axles are steel tubular and frame is of structural steel. The wheels are ball bearing, 52 one-half-inch balls being used in each wheel, running in bearings absolutely frictionless. The wheels can be removed without disturbing the bearings.

The other electrical novelty from the Chicago show noted in this article is the "long-distance" carriage of the National Vehicle Company, of Indianapolis. As will be observed, half the battery—or 36 cells—is carried under a polished brass hood in front of the vehicle, giving it a close resemblance to the ordinary gasoline automobile. The other half of the battery is carried in the body at the back, thus distributing the weight fairly and evenly over the two axles and the truck frame. The cells are those of the Western Storage Battery Company, and the vehicle is estimated to have a radius of 100 miles on one charge. Moreover, the motor can be reversed so as to generate current and operate as a brake. The motor is sup-

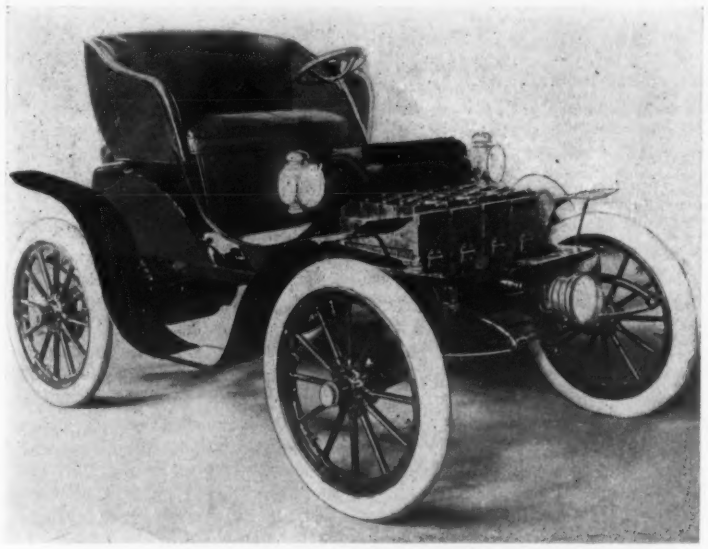


FIG. 2.—LONG-DISTANCE CARRIAGE.

ported on the rear axle, at the center, and is placed with the reduction gears in an outer cylindrical case. Steering is effected by a hand wheel. The brakes are on drums on the drive wheels and set by a foot lever. The frame is angle iron, mounted on full elliptic springs at the rear and half elliptics in front. The vehicle is quite handsome in appearance and weighs 1,600 pounds. To all outward seeming it is a gasoline vehicle, as will be noted from the engraving.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered freely as to amount, but prices held firm, there being a good demand for short periods. The closing rates were 6 per cent. for 60 to 90 days and 5¾ a 6 per cent. for four, five and six months. In the stock market there was a better feeling and the tendency was toward higher prices. Electrics on the whole were rather inactive and the market in this class of securities was not affected by any general cause. Each stock seemed to fluctuate independently, due probably to particular causes. Among the tractions, Brooklyn Rapid Transit showed a downward tendency, closing at 65¼, this being a net loss of ¼ point. Metropolitan Street Railway lost 1⅛, closing at 133¾ after dropping to 131⅝, the agregate sales being 65,250 shares. General Electric was the exception in the industrial list in point of activity and strength, closing at 193½, this being a net gain of 3 points. Westinghouse, on sales of 700 shares, closed at 202, being a net loss of 8 points. Other closing quotations were American Telegraph & Cable, 82¼, a net loss of 1½ points; Commercial Cable, 165, a net gain of 4 points, and Western Union, 89¾, a net loss of 1¼ points. Among the features in the trading on the curb during the week was the decline in United States Steel 5 per cent. bonds and rights. The general list was irregular but fairly steady at the close of the week after early heaviness. An interesting incident of the week was the offering of United Copper shares, the Heinze Company, at "seller 60" and "seller 15" at a considerable reduction in price by reason of the proposed extension of the syndicate, and suspicions that few shares have apparently been taken by the public. Other copper shares were pressed for sale by their respective pools, following the sharp rise in the metal. Following are the closing quotations of March 17:

NEW YORK.

	Mar. 10.	Mar. 17		Mar. 10.	Mar. 17
American Tel. & Cable	80	80	General Electric	190¼	192
American Tel. & Tel.	163	164⅜	Hudson River Tel.	..	..
American Dist. Tel.	37	37	Metropolitan St. Ry.	132⅝	133¾
Brooklyn Rapid Transit	63⅞	64⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	21	20	N. Y. E. V. T. Co.	9	8½
Electric Boat pfd.	30	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	2⅜	2⅝	Western Union Tel.	88¾	89⅝
Electric Vehicle.	8	8½	Westinghouse com.	195	205
Electric Vehicle pfd.	13¼	14½	Westinghouse pfd.	200	218*

BOSTON.

	Mar. 10.	Mar. 17		Mar. 10.	Mar. 1
American Tel. & Tel	163¾	165	Western Tel. & Tel. pfd.	99	99
Cumberland Telephone	..	..	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum.	..	..	New England Telephone	138	138
General Electric	192½	..	Westinghouse	100	100
Western Tel. & Tel	23	22	Westinghouse pfd.	102	100

PHILADELPHIA.

	Mar. 10.	Mar. 17		Mar. 10.	Mar. 1
American Railways	50	..	Phila. Traction	97	97¼
Elec. Storage Battery	..	70½	Phila. Electric	6⅞	7⅛
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America.	8⅞	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Mar. 10.	Mar. 17		Mar. 10.	Mar. 17
Central Union Tel.	..	..	National Carbon pfd.	98	99
Chicago Edison	159	..	Northwest Elev. com.	..	..
Chicago City Ry.	210†	210	Union Traction	9¼	9¼
Chicago Tel. Co.	..	..	Union Traction pfd.	42	42
National Carbon	24	24½			

*Asked. †Ex Dividend.

ALBANY & HUDSON REORGANIZATION.—The Albany & Hudson Railroad Co. was incorporated last week with a capital of $27,000,000. The company has acquired the property and franchises of the Albany & Hudson Railway and Power Company, which operates the third rail electric line from Albany to Hudson. The property and franchises were acquired after the latter company had gone into the hands of a receiver after the two serious collisions due to the carelessness of motormen, which impoverished it. The directors are H. G. Runkle, C. L. Rossiter, A. M. Young, Foster M. Voorhees, William F. Sheehan, R. A. C. Smith and H. L. Seibert, of New York; Horace Andrews, of Cleveland, Ohio, and Seth L. Keen, of Brooklyn. The directors of the new railroad are prominent in traction enterprises in this and other cities. A. M. Young, H. G. Runkle and R. A. C. Smith represent a syndicate which has been very active in traction matters in New England. Their offices are located at No. 100 Broadway. C. L. Rossiter, W. F. Sheehan and H. L. Seibert have been more or less identified with Brooklyn Rapid Transit. Mr. Rossiter was at one time president of that corporation and Mr. Sheehan is its general counsel. Mr. Seibert is at present a director of the Brooklyn company. The road is an excellent property, and is developing a large earning capacity.

DIVIDENDS.—The executive committee of the Western Union Telegraph Company has recommended the declaration of the regular quarterly dividend of 1¼%. Directors of the General Electric have declared the regular 2% quarterly dividend, payable April 18. The directors of the Westinghouse Electric & Manufactnring Company have declared the regular quarterly dividend of 1¾% on the preferred stock, payable April 1. The directors of the Electric Storage Battery Company have declared the regular quarterly dividends of 1¼% on the common and 1¼% on the preferred, payable April 1. The directors of the Hall Signal Company have declared the regular quarterly dividend of 1½% on the common stock, payable April 1. An annual dividend of 6% was also declared on the preferred, payable April 1. Chicago Telephone directors have declared a regular quarterly dividend of 2½%, payable March 31. The directors of the Union Switch & Signal Company have declared dividends of 2¼% on the preferred and 1½% on the common. This makes the preferred a 9% stock and the common 6%. The Boston Suburban Electric Company has declared a regular quarterly dividend of $1 on the preferred stock, payable April 15.

WESTERN UNION EARNINGS.—The fiscal year of the company began July 1 last, and the returns now in show actual net earnings over all expenses, including interest on bonds, as follows:

Quarter ended September 30 last	$1,994,624
Quarter ended December 31 last	1,864,780
Total for the half year	$3,859,404
Add estimated net earnings for the current quarter	1,590,000
Makes total earnings for the three quarters (one quarter estimated)	$5,449,404

Or at the rate of 7.44% for the fiscal year. The first part of the statement reviews the figures for the preceding quarter, and shows that the net earnings of that quarter, ended December 31 last, after deducting interest on bonds, were $1,864,780, which is $17,330 more than the estimate made three months ago, and $250,000 more than the earnings of the corresponding quarter one year ago.

LAKE SUPERIOR COMPANY'S AFFAIRS.—The statement of Vice-President Search, of the Consolidated Lake Superior Company, to the stockholders, was made public this week by John W. Moffley, chairman of the stockholders' committee now investigating the affairs of the corporation. The statement in part is as follows: The Ferro-Nickel Reduction Works at Sault Ste. Marie, fully equipped and in operation, represent an investment of $499,700. In water power development and equipment the company has invested, on the Michigan side, $2,923,600, in addition to the proceeds of $3,500,000 of bonds issued by the Michigan Lake Superior Power Company. The Tagona water and light plant represents an investment of $161,000, in addition to the sum invested from the proceeds of the $160,000 of bonds of that company outstanding.

BELL TELEPHONE.—The stockholders of the American Telephone & Telegraph Company will hold a special meeting in this city on March 31 for the purpose of voting on a proposition to increase the capital stock of the company from $150,000,000 to $250,000,000. This increase of $100,000,000 is to be used as necessity demands, and is not all to be issued at once. The stockholders will also be asked to act on a proposition to limit the number of vice-presidents. A decrease of 2,073 instruments is reported on the net output of the American Telephone & Telegraph Company for the month ended February 20, as compared with same period last year, but a net increase of 31,862 instruments since December 21 last.

ELECTRIC GROWTH AT GENOA, ILL.—The Eureka Electric Company and the Advance Electric & Telephone Company, both of Chicago, have consolidated with a total capital of $150,000, and will remove to Genoa, Ill. Bids will be received for the erection of a two-story brick building, 96 x 225, of mill construction. About 40 new houses, required for employees, and other buildings will be erected. E. C. Shippee, John Hadsall, Thomas Sager, all of Genoa, can give information. The negotiations were conducted by Funk, Lawrence & Co., Security Building, Chicago.

STROMBERG-CARLSON INCREASE OF STOCK.—At a meeting of the stockholders of the Stromberg-Carlson Telephone Mfg. Co., held in Rochester, N. Y., on March 9, it was voted to increase the capital stock from $3,000,000 to $4,500,000. The total stock will consist of 15,000 shares of preferred and 30,000 shares of common stock, the par value being $100 each. The company has been doing a very large business.

OTIS ELEVATOR ANNUAL REPORT.—The annual report of Otis Elevator for the year ended December 31 shows as follows:

	1902.	1901.	Changes.
Net earnings	$978,410	$842,096	Inc. $136,314
Dividends	411,835	267,539	Inc. 144,296
Surplus	$566,575	$574,557	Dec. $7,982
Depreciation	266,575	274,557	Dec. 7,982
Surp. added to working capital	300,000	$300,000	.....

President W. D. Baldwin says that during the past year the volume of the company's business has very materially increased, thereby justifying the action of the directors in making the large expenditures during the past three years for increasing and improving the company's plants, all of which expenditures, other than those made for the purchase of real estate and the erection of new buildings have been charged to operating expenses. The preferred stock has been increased from $4,500,000 to $6,500,000 and about $1,000,000 of this increase remains in the treasury, while 9,895 shares were issued and sold for cash. The proceeds were used in taking up all outstanding notes (except the 4 per cent. gold notes), and to pay current liabilities. Of the 4 per cent. gold notes, $150,000 maturing in December, 1902, practically all were anticipated and paid before they became due. The cash received from the sale of the preferred stock has enabled the company to declare the dividend of 2 per cent. on the common stock. The prospects for the current year are said to be very promising.

ERIE CANAL TOWAGE.—Mr. John Murray Mitchell, counsel for the International Towing & Power Company, has made estimates showing what the operating expenses on the Erie Canal would be under the Wood electric system. The plan, as laid before the canal committee at Albany, is for an electric motor car, which, traveling on a rail at the towpath's edge, should tow boats at a speed of four miles an hour. The entire system would be leased on a royalty basis to the State, which would rent the motors to the boat owners. The Wood electric system, Mr. Mitchell declares, would be superior to the 1,000-ton barge canal proposition. The interest on the cost of the barge canal, $100,000,000, at 5 per cent., would equip the Erie Canal with the Wood system, he says; and, further, it would take five years, according to the State Engineer, to deepen the canal sufficiently for 1,000-ton barges, and during those five years the canal would be idle, losing business amounting to $3,500,000 a year. Not only would this income be lost, but the $1,000,000 a year now paid for maintenance would also be a loss, he points out, as the expense of the "canal establishment" would go right on. The Wood system, on the contrary, Mr. Mitchell says, would solve all difficulties. The operation of the system would not interfere with the use of the present towpath; the power to operate the motors could be acquired from the power plants now along the canal, or the State could use water power. The cost of a 1,000-ton steam barge, $25,000, would debar individual investors and most of the present canal operators, Mr. Mitchell says.

WESTERN TELEPHONE ANNUAL.—The Western Telephone & Telegraph Company, which succeeds the old Erie Telephone & Telegraph Company, issues its report for the year ended January 31, 1903, as follows:

Gross earnings		$453,623
Dividends		850,586
Total net receipts		1,304,209
Interest and taxes	$519,343	
General expenses	24,537	
Depreciation (including $70,621 interest not now collectible)	86,478	
		630,360
Net reserve		673,849
Dividends		640,000
Surplus		33,849

President Fish says: "The earning property of your company consists chiefly in a controlling interest in the capital stock of the Northwestern Telephone Exchange Company, the Cleveland Telephone Company, the Wisconsin Telephone Company, the Southwestern Telephone & Telegraph Company, and the Michigan Telephone Company. These four companies have expended during the past year in improvements and development $2,203,193, of which $282,086 was for underground work, $629,044 for toll lines, $547,178 for switchboards and other equipment, $73,462 for real estate and buildings and $671,423 for exchange aerial construction. The money so expended was supplied by this company. At the end of the year the total number of subscribers' stations in the four companies now under consideration was 111,036, in addition to those under sub-license contract, which numbered 25,753, a gain of 19,732 in the exchanges of the four companies and 11,315 in the sub-license exchanges. The situation of the Michigan Telephone Company, of which company the Western Telegraph & Telephone Company is a creditor to the extent of more than $1,700,000, as well as principal stockholder, is far from satisfactory." The company is now in the hands of a receiver.

Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing the trade conditions of the past week, *Bradstreet's* sums up the situation in stating that the demand is active, with staple prices strong at close to record levels, despite drawbacks in the shape of bad roads, labor troubles East and West, heavy rains, overflowing rivers and backward farm preparations at the south. Labor troubles, present and prospective, especially harass the building trade consuming iron and steel in the metropolis. The traffic congestion, although improved, still affects the transportation of coke, lumber, flour and grain. Railroad earnings are excellent for this time of the year. The country's railroads in February showed gainings of 14 per cent. in gross receipts, and the early March returns are fully as favorable. Export trade showed a very notable gain in February in many lines, particularly in the shipment of corn and cotton. According to *Dun's Review*, the reports of foreign commerce are fully as satisfactory as those respecting domestic trade, exports from the port of New York exceeding those of the same week last year by $5,875,593, or over 60 per cent. The copper market was active, the price of the metal reaching the highest figure in several months. This result, however, it is stated, is due to the speculative element, since consumers show no tendency whatever to engage in the "boom." The upward movement of prices is slow but steady, and on Thursday it reached 15 cents nominally, for lake, electrolytic and casting stock. Despite the strength of the market, there are many people who regard the present prices as largely fictitious and not warranted by the trade conditions.

THE TEXAS FLAT MINING COMPANY, of Madeira County, Cal., has taken its place among modernly equipped mines by purchasing from the Westinghouse Electric & Manufacturing Company one 75-kw, 2,200-volt, 3-phase, 60-cycle, alternating-current generator, 720 r.p.m.; one 1.87-kw, 125-volt, direct-current exciter, 1,800 r.p.m.; one switchboard panel, one 40-hp, 3-phase, 400-volt induction motor, 850 r.p.m.; one 20-hp, 3-phase, 400-volt induction motor, 1,120 r.p.m.; one 10-hp, 3-phase, 400-volt induction motor, 1,120 r.p.m.; three 30-kw, oil-insulated, self-cooling, lowering transformers, converting from 2,100 volts to approximately 420 volts; one 3-kw transformer for lighting circuit, converting from 2,100 volts to approximately 105 volts, and the various accompanying details of electrical equipment. The generator will be installed about three miles from the mine, and will furnish the power necessary to operate a 20-stamp quartz mill, with rock-breaker, concentrators, etc.; and will, also, run two hoists.

EQUIPMENT FOR JAPANESE ROAD.—Francis A. Cundill, 90 Wall Street, New York City, who acts as American representative for the British electrical engineering and contracting firm of L. J. Healing & Co., of Yokohama, has placed a contract with the Albert & J. M. Anderson Manufacturing Company for the line material to be utilized in the double overhead construction of a system to be built by the Yokohama Tramways Company, from Yokohama to Kanagawa, a distance of about four miles. The road, which is to be constructed with Japanese capital, will be the first electric traction system to be operated in that Japanese city. The poles—331 in number, with brackets—will be supplied through the Healing concern by the Railway Supply & Equipment Company, of Cincinnati, Ohio. Although all the other contracts have not yet been fully determined on it can be said now that the major portion of the various equipments for the Yokohama road will be purchased in the United States.

ELECTRICAL MACHINERY EXPORTS.—The Treasury summary of exports for the month of January shows the amount of electrical machinery to have been $556,315, as compared with $409,476 in January, 1902. The export for the seven months reached $3,668,432, as compared with $2,963,696 in the corresponding seven months of 1901-2. The export of electrical instruments for January, 1903, was smaller than usual, being $239,234, as compared with $419,098 in January, 1902. But the total for the seven months was $2,496,368, as compared with $2,248,000 in the corresponding period of 1902. The falling off appears to have been chiefly in Australia and British South Africa.

ROYAL ELECTRIC CONTRACTS.—Improvements in the municipal lighting plant, Lebanon, O., have been completed and operations will be resumed this month. A 300-hp McEwen engine has been installed and a 180-kw Royal Electric Co. alternator. The trustees of the City of Newton, Ill., have also placed an order with the Royal Electric Company, of Peoria, Ill., for one 120-kw alternator and one 200-hp engine.

THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, has purchased the plant formerly occupied by the Alfree Engine Company in that city. The plant is well equipped with large machine tools and will greatly increase the company's manufacturing facilities. A large increase has been made in the capital stock of the company.

SOME C. & C. FOREIGN AND DOMESTIC ORDERS.—The C. & C. Electric Company, of Garwood, N. J., which is considerably enlarging its offices in the Liberty Building, has secured within the last few days a number of foreign and domestic contracts for generators, motors, etc. The export business included an order taken through C. R. Heap, 47 Victoria Street, London, for a 75-kw belted generator and four-belted motors, varying from one hp to 10 hp for installation in the London printing press works of R. Hoe & Co. Another foreign order calls for the shipment of a 65-kw belted generator and switchboard for the plant of the Montezuma Lead Company, Mexico. The Metropolitan Printing Company, New York, has requisitioned for over 20 C. & C. motors, varying in capacity from 5 hp to 20 hp, which are to be used for driving printing presses. The majority of the motors are to be direct-belted. The Buckingham Apartment Hotel, Pittsburg, Pa., is to be equipped with two 75-kw and one 25-kw generators for direct-connection to engines to be built by the Watertown (N. Y.) Engine Company, of 115 hp and 40 hp respectively. The Standard Steel Company, Burnham, Pa., has ordered two more 50-hp motors, which will make the tenth order for motors of similar capacity received from the same source by the C. & C. Company within the last four months. A 125-hp belted generator—the third one—has been ordered for installation in the Chicago shops of the Allis-Chalmers Company. The Standard Electric Company, of New Orleans, has sent in an order for two 30-kw generators, direct-connected to Harrisburg engines. The Rogers Locomotive Works, Paterson, N. J., are to be equipped with an 80-hp motor, also a 30-hp machine for direct-connection to heavy machine tools. The Rogers plant will also be furnished with a 125-kw belted generator. The Edison Electric Illuminating Company, Brooklyn, has ordered a 125-kw booster. This will make the fourth order for similar apparatus. The C. & C. people also report recent receipt of several smaller domestic orders for dynamos and motors.

AMERICAN EQUIPMENT FOR CANADIAN LOCOMOTIVE PLANT.—The extensive locomotive plant now under construction at Montreal, Canada, by the Locomotive & Machine Company, Limited, is to be installed with American electrical equipment for light and power. The contract for the motors—80 in number and varying from 5 hp to 50 hp—has been awarded to the Westinghouse Electric & Manufacturing Company, Limited. These machines will be direct-connected on three-wires. About half the motors will be run at variable speed for direct application to machine tools. The Western Electric Company took the contract for a 400-kw generator. These contracts were secured, notwithstanding that American manufacturers had to combat an import tariff of 25 per cent., the Canadian manufacturer of electrical machinery having quoted higher prices. The contracts for the machine tools, aggregating about $300,000, have been about equally divided between Canadian and American builders. John Bertram's Sons, of Dundas, Ont., which is the largest machine tool building concern in Canada, and represents the interests in that part of the world of several United States firms, secured a contract which will represent an expenditure not far short of $130,000. About two-thirds of these tools will be made after American models at the Bertrams' plant. The remainder will be built in the United States. The principal contract allotted to American concerns was awarded to the Niles-Bement-Pond Company, 136 Liberty Street, New York, for heavy locomotive building tools. The value of the contract is about the same as the Canadian one. The principal orders for the other tools went to Manning, Maxwell & Moore, 85 Liberty Street, and the Prentiss Tool & Supply Company, 115 Liberty Street, New York.

FEBRUARY EXPORT TRADE.—The export trade of the United States is rapidly resuming its normal conditions. February figures of the Bureau of Statistics show the largest exports of any February in the history of our commerce, and also show that the exports of the three months ending with February were larger than those of the corresponding period of any earlier year. On the import side the figures also show a continuation of the growth which has characterized the last two years, and the figures of the eight months ending with February suggest that the imports of the United States in the fiscal year 1903 may exceed a billion dollars, while the export figures seem likely to exceed one billion, four hundred millions. In the short month of February alone the exports amounted to $125,502,105, which is 12 millions in excess of any preceding February, and more than double the figures of February, 1893, in which month the total exports were $59,931,984. Taking the three months ending with February, 1903, the total exports are $407,526,200, against $215,151,471 in the three months ending with February, 1893. Thus, considering either the month of February or the three months ending with February, 1903, the total exports are not only larger than in that period of any preceding year, but practically double those of a decade ago.

SOME BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, through its New York offices, Mr. Paul Bigelow, manager, has secured a contract for a 375-hp compound condensing engine for direct connection to a 250-kw Westinghouse engine. This equipment is intended for lighting and power purposes in the new Staten Island structural material plant of Milliken Brothers. Two 225-hp Buckeye simple engines for belting to 150-kw generators have been ordered by the New York Mutual Gas Light Company, foot of East Eleventh Street, New York. A 175-hp simple engine for direct connection to a Bullock generator of 115 kw capacity has been requisitioned for power use in the New Haven (Conn.) plant of the Seamless Rubber Company. The Naugatuck (Conn.) Malleable Iron Company has sent in an order for a 375-hp cross-compound condensing engine for installation in the Wilmington (Del.) Malleable Iron Company's plant at Wilmington, Del. This will make the twenty-third order received by the Buckeye people from the same source. The E. M. Brown Paper Company's plant at Ballston, N. Y., is to be equipped with a 110-hp Buckeye simple engine to be belted to a generator.

BALL ENGINE ORDERS.—The Hull House, Chicago, is installing a direct-connected unit, the engine being furnished by the Ball Engine Company, Erie, Pa., and the generator by the Western Electric Company. The Duquesne Brewing Company, Pittsburg, has installed a direct-connected unit of 125 hp, the Ball Engine Company furnishing the engine and the Westinghouse Electric & Manufacturing Company the generator. The Union Trust Co. Building, Baltimore, has recently placed in operation an 80-hp, direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine and the General Electric Company the generator. The Fayhall Mine, of the Minnesota Iron Company, Eveleth, Minn., will have an electric lighting plant of 100 hp, the engine being furnished by the Ball Engine Company.

THE ATLANTIC CITY & SUBURBAN TRACTION COMPANY is constructing a suburban electric railway extending from the famous Board Walk at Atlantic City to Pleasantville, N. J., from which place the road will branch in two direction, one leading to Absecon and the other to Somer's Point, a total distance of approximately eighteen miles. This road will operate twelve cars, each being equipped with four Westinghouse motors and five trail cars. The following electrical apparatus is also to be installed in the power house at Pleasantville: Two 400-kw, direct-current, Westinghouse railway generators, running at 550 volts and 125 r.p.m., together with a switchboard which will be of the standard Westinghouse railway type and consist of two generator panels, one load panel and four double-feeder panels.

THE WESTINGHOUSE AIR BRAKE COMPANY will at once begin the erection of a new foundry to be 320 ft. long by 65 ft. wide, and constructed of brick with steel frame. This foundry will be located just west of the present air brake works at Wilmerding, Pa., and has been made necessary by the greatly increased demand for castings used in the apparatus manufactured by this company. Owing to the development of the traction brake business, the Air Brake Company's present foundry facilities have been overtaxed for some time past and in order to insure greater efficiency in production and prompt delivery of material it has become necessary to provide greater capacity. This addition to the plant will materially increase the brake company's working force, now numbering about 3,000 men.

ANDERSON LINE MATERIAL ORDER.—The Albert and J. M. Anderson Company, Boston, Mass., through its New York offices, 135 Broadway, has secured a contract for the line material to be utilized in the construction of the Sheffield-Tuscumbia (Ala.) electric traction system, of which L. H. McIntire, at one time manager of the Savannah (Ga.) street railway system, is the consulting engineer, and whose office is in the Morris Building, New York. The Anderson Company has taken the order for the large switchboard, etc., to be installed in the Wall Street Exchange Building.

ELECTRICAL EQUIPMENT FOR NEW BRUNSWICK (N. J.) PLANT.—The plant of the Janeway Button Company, of New Brunswick, N. J., is to be electrically equipped, the contract having just been secured by the A. D. Granger Company, White Building, 95 Liberty Street. The initial installation will have a capacity of 120 hp. The engine will be of Corliss type and will be built by the Watts-Campbell Company, of Newark, N. J. The orders for the generator, etc., have not yet been let by the Granger Company.

ELECTRIC STORAGE BATTERY.—A director of the Electric Storage Battery Company states that the annual report to be presented to stockholders will show a considerable increase in earnings over the previous year, and heavier gains for the months of January and February, 1903, against last year January and February.

MORE UNITED STATES EQUIPMENT FOR CANADA.—The Montreal (Can.) Terminal Railway Company has awarded a contract to the C. & C. Electric Company, 143 Liberty Street, New York, for the supply of two railway generators of 200 kw capacity each.

General News.

THE TELEPHONE.

DENVER, COL.—The Citizens' Automatic Telephone Company, capital $500,000, has been incorporated by J. C. Shields, F. F. Castello, A. T. Gunnell and others.

BARNESVILLE, GA.—The sale of the Barnesville telephone exchange to the Southern Bell Telephone Company has been confirmed before a referee.

GRAYMONT, ILL.—The Friendship Telephone Company has incorporated with a capital of $2,500.

MANLIUS, ILL.—The Bureau County Mutual Telephone Company, with a capital stock of $2,500, has been incorporated by J. J. Stauffer, Ben Monson and A. L. Martin.

CHICAGO, ILL.—The Central Illinois Telephone & Telegraph Company has been incorporated at Jersey City, N. J., with a capital stock of $500,000. The capital in Illinois is $50,000.

LINCOLN, ILL.—The stockholders of the Lincoln Mutual Telephone Company have decided to accept the offer of the Central Illinois Telephone & Telegraph Company to assume the bonded and floating indebtedness of the former concern, pay the stockholders $100 a share and guarantee existing rates for a period of five years, which are $12 for residences and $24 for offices and business places.

THORNTON, IND.—The Thornton Telephone Company has increased its capital stock from $2,500 to $6,000. Wm. Brenton is president and G. Lyster, secretary.

WINCHESTER, IND.—The Winchester Telephone Company has increased its capital stock from $2,750 to $25,000. The company will make improvements and extensions.

SWEETSER, IND.—The Sweetser Telephone Company has filed articles of incorporation. Capital stock $10,000. James E. Carry, F. H. Stephens, James Dooley are interested.

CLAY CITY, IND.—It is stated that the Bell Telephone Company, which put in its service in this city two years ago in opposition to the Home Telephone Company, has discontinued its service, having lost $4,000 in the venture.

ANDERSON, IND.—The Anderson and Fall Creek Telephone Company has filed articles of incorporation, with a capital stock of $14,000. Winfield Scott, of Anderson, and Harry Welz, of Pendleton, are president and secretary respectively.

WARSAW, IND.—The Home Mutual Telephone Company, of Stoney Point, Kosciusko County, has filed articles of incorporation. Capital $10,000. Joel Hall, of Warsaw, W. B. Anglin, Alonzo Bucket and Z. T. Byers, of Etna Green, are the directors.

LOGANSPORT, IND.—The county commissioners have granted a franchise to the Burrows Telephone Company to construct and operate an independent line in Cass County. The company recently incorporated with a capital stock of $8,000. It will do a farm and village business.

INDIANAPOLIS, IND.—The Bell Mutual Telephone Company has filed articles of incorporation with a capital stock of $400,000. H. S. Offenback, Robert E. Bell and Asa Hamilton are the incorporators. The company will construct lines and operate in Marion, Hancock and Hamilton Counties.

PATRIOT, IND.—The Posey Mutual Telephone Company has filed articles of incorporation with a capital stock of $25,000. The company will construct and operate telephone exchanges and telephone lines in the counties of Switzerland and Ohio. Edwin R. Mead, Elmer Palmer, and H. S. Humphrey are directors.

WAKARUSA, IND.—The St. Joseph Union Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The company will establish exchanges at Claudville and Wakarusa, construct and operate lines in St. Joseph and contiguous counties. E. L. David Bizar, A. T. Gocker, Wakarusa, and C. B. Nettrow, Claudville, are the incorporators.

FISHER'S STATION, IND.—Articles of incorporation have been filed by the Fisher's Station and Oaklandon Telephone Company. The capital stock is $4,000. The company proposes to establish exchanges at Fisher's Station and Oaklandon, and will erect and operate lines extending into Marion and Hamilton counties. Jonathan Conkle, Bert Klepfer, of Oaklandon, and John R. Hoss, Abraham S. Neaver, of Fisher's Station, are the incorporators.

IRETON, IA.—The Ireton Local Mutual Telephone Company has secured a franchise in this place.

DES MOINES, IA.—The Manley Telephone Company has been incorporated with a capital stock of $10,000. Mr. Parker is president and P. A. Bryant, secretary.

AUBURN, KY.—Herschell Helm, of Morgantown, has bought the exchange at Auburn formerly owned by Blakely Helm. The system will be improved.

BILLINGS, MONT.—The stockholders of the Montana-Wyoming Telephone Company will meet here next month to increase the capitalization from $40,000 to $100,000 for the purpose of raising necessary capital to make needed improvements.

PENN YAN, N. Y.—The Torrey Telephone Company, capital $5,000, has been incorporated by F. E. Spencer, E. B. Thayer and E. C. Gilbert.

CANANDAIGUA, N. Y.—The Ontario & Steuben Telephone Company will build a trunk line from Naples to Bath with a branch to Wayland and will increase its capital to $25,000.

NEW YORK, N. Y.—The Astor House, the Fifth Avenue Hotel and the Hotel Grenoble are being equipped throughout with Bell Long Distance telephone service. Two hundred and seventy-five stations are being installed at the Astor House; 360 stations at the Fifth Avenue, and 100 stations at the Hotel Grenoble.

GASTONIA, N. C.—The Piedmont Telephone Company, Gastonia, now operates telephones in 23 towns. The recently purchased exchange at Shelby, N. C., will be rebuilt. A long distance line from Lincolnton to Asheville, N. C., will also be built.

CAREY, OHIO.—The Carey Electric Telephone Company has increased its capital stock from $6,000 to $25,000 and will make important extensions. H. I. Graves is president of the company.

APPLE CREEK, OHIO.—The Franklin Union Telephone Company has been incorporated, with $1,500 capital stock, by Frank E. Beazell, A. D. Eyman, J. E. Franks, J. W. Tate and others.

LOGAN, OHIO.—The Citizens Telephone Company, of Logan County, has been purchased by W. H. Fledderjohann and A. Van Gordon. The system will be extended and will be known as the Logan Home Telephone Company.

WARREN, OHIO.—The directors of the Madison Telephone Company have decided to expend $10,000 in extending its lines in Lake and Ashtabula counties. Important improvements will be made in the Geneva and Madison exchange.

POINT ROCK, OHIO.—The Point Rock & Wilkesville Independent Telephone Company has been incorporated, with a capital stock of $4,000, by J. L. Westfall, George Barnes, E. H. Fletcher, W. R. Trainer and Walter Cooper.

PHALANX, OHIO.—The Phalanx-Leavittsburg Telephone Company has been incorporated, with $5,000 capital stock, by W. O. Chaffee, C. F. Ivers, C. J. Rood, D. H. Leiby and others. It will build a line from Leavittsburg to Phalanx.

CLEVELAND, OHIO.—Members of the Everett-Moore syndicate deny that there is any truth in the report recently sent out from Pittsburg, to the effect that the Elkins-Widener syndicate had purchased the United States Telephone Company.

DEERFIELD, OHIO.—The North Benton-Deerfield Telephone Company, of Mahoning County, has been incorporated, with $1,000 capital stock, by A. R. Cobbs, G. B. Kinsey, C. W. Hartzell, E. E. Walker, L. F. Pearce and others.

HARPERSFIELD, OHIO.—Farmers in the vicinity of Harpersfield have decided to incorporate the Harpersfield Home Telephone Company. About fifty telephones have been connected to a central station at Cork. The system will be extended throughout the district.

SANDUSKY, OHIO.—The Sandusky Telephone Company now has 1,100 subscribers as compared with 670 for the established Bell Company. This year's business will show a surplus for stock of about 11 per cent. Rates are $18 for residences and $30 for business.

CINCINNATI, OHIO.—The independent telephone people have made a long step towards entrance into Cincinnati. The United States Telephone Company has perfected an arrangement with the Miami & Erie Canal Transportation Company whereby its lines will be extended into Cincinnati on the poles of the canal company.

LIMA, OHIO.—The Lima Telephone Company has issued $75,000 worth of preferred stock which has been taken up by present stockholders at 80. The money derived will be used to enlarge the switchboard and install 500 new telephones in Allen County. At present the company has 1,087 telephones in operation. E. J. Cable is president of the company.

TOLEDO, OHIO.—The Toledo Home Telephone Company at its annual meeting will vote to spend $30,000 on new cable and an extension to the switchboard. The company is now serving 6,000 subscribers and is growing rapidly. General Manager Hamlin denies the truth of the report that the company contemplates an immediate increase in rates.

ZANESVILLE, OHIO.—The Zanesville Telephone Company, one of the subsidiary companies controlled by the Federal Telephone Company, has elected these directors: F. S. Dickson, W. L. Carey, J. B. Hoge, Maxime Reber, H. A. Sharp, S. M. Granger, J. B. Rhodes and W. C. Handschy. The company will make extensive improvements, material for 1,000 additional telephones having been contracted for. Exchanges will be installed in the nearby towns.

HOOD RIVER, ORE.—The Rural Telephone Company, of Hood River, has been incorporated, with a capital stock of $10,000, by J. H. Shoemaker, James T. Shaw and W. B. Johnson.

MONTREAL, QUE.—At the annual general meeting of the shareholders of the Bell Telephone Company of Canada, held in Montreal, the report of the directors showed that 5,623 new subscribers were added during the year, the total number of sets of instruments now earning rental being 48,481. The company now owns and operates 377 exchanges and 553 agencies. Over 2,655 miles of wire have been added to the long distance system in 1902. The long distance lines now owned and operated by the company comprise 26,848 miles of wire on 6,991 miles of poles. There were $250,000 worth of 5 per cent bonds sold during the past year, the premium on which amounted to $22,809. All the retiring officers were re-elected.

EAGLEVILLE, TENN.—The Cumberland Telephone Company contemplates installing an exchange at Eagleville.

SPARTA, TENN.—The Gainesville Telephone Company, with headquarters at Sparta, will extend its lines to a number of towns connecting with the Cumberland Telephone Company at Stanford, Ky.

GREENVILLE, TENN.—A meeting of representatives of the independent telephone lines of Greenville was held to consider consolidating and unless suitable arrangements are concluded with the Cumberland Company it is proposed to unite and establish a central station in Greenville.

MONROE, WIS.—The Brodhead Telephone Company has increased its capital stock from $5,000 to $15,000 for the purpose of extending its system. A dividend of 5 per cent. was paid.

ELECTRIC LIGHT AND POWER.

HUNTVILLE, ALA.—A bill has been passed by the State Legislature granting this city permission to issue $20,000 bonds for an electric light plant.

NEW DECATUR, ALA.—It is reported that the Decatur Light, Power & Fuel Company will soon make extensive improvements to its electric light and gas plants here.

BIRMINGHAM, ALA.—The Judiciary Committee of the City Council has recommended that T. H. Aldrich, representing the Birmingham District Coal, Light & Power Company, be granted a franchise for an electric light and gas plant.

DE QUEEN, ARK.—The De Queen Light, Ice and Cold Storage Company has been incorporated with a capital stock of $50,000. J. S. Lake is president, Frank Ogden, vice-president, I. O. Bunyon, secretary and treasurer.

QUEBEC, CAN.—There is at present every indication that the Quebec & Jacques Cartier Electric Power Company and the Quebec Railway, Light & Power Company will soon be amalgamated. The stock of the former company is controlled by American capitalists, while the latter is owned and managed by a number of Quebec citizens. The Quebec & Jacques Cartier Electric Power Company has made an offer to purchase the interests of the other company, but without success. Recently negotiations were entered into with a view to amalgamate the two companies, and are still in progress.

ATLANTA, GA.—The council committee on lights will immediately advertise for bids for furnishing the city with electric lights. It is believed that the proposal of J. Frank Lester to build a combined crematory and lighting plant will, however, be adopted.

QUINCY, ILL.—The Independent Light & Power Company has been incorporated with a capital of $200,000. Incorporators: J. W. Cassidy, C. E. Mead and L. P. Wheeler.

BLOOMINGTON, IND.—The legislature has appropriated $20,000 for a lighting and heating plant for the State University.

HARTFORD CITY, IND.—This city having tired of municipal ownership and its failures, has sold its electric light plant to Chicago capitalists, headed by George Mayer, who will improve and enlarge the plant.

INDIANAPOLIS, IND.—A bill has passed the legislature authorizing the city of Indianapolis to make long-term contracts for electric light. This will enable companies to bid on the new contract to be let in July.

LEWIS, IA.—Daniel Stevens has petitioned for an electric light franchise.

ODEBOLT, IA.—The Odebolt Lighting & Heating Company has been incorporated with a capital of $12,000. Jos. Mattes is president and E. W. Lester, secretary.

GUTHRIE CENTER, IA.—The Guthrie Center Electric Light Company has been incorporated, with a capital of $15,000, by W. F. Moore, C. G. Trent, Sr., Alex. H. Grisell and others.

CROWLEY, LA.—It was voted March 5 to issue $100,000 bonds for an electric light plant and water works.

MERRIMAC, MASS.—A committee has been appointed to investigate the cost, etc., of installing water works and an electric light plant. Probably only preliminary work will be done this year.

SCHOOLCRAFT, MICH.—The citizens voted on March 9 to issue bonds for the construction of an electric light plant. J. W. Budrow is the village clerk.

DEXTER, MICH.—It was voted March 9 to issue $8,000 bonds for an electric light plant. J. W. Barley is clerk.

MANKATO, MINN.—W. I. Gray, of Minneapolis, has been selected to prepare plans for a municipal electric light plant.

SOUTH STILLWATER, MINN.—The question of issuing $20,000 bonds for an electric light plant will probably be submitted at the next election.

NATCHEZ, MISS.—The Natchez Gaslight Company has been indirectly absorbed by the Electric Street Railway Company, $100,000 being involved.

COLLINS, MISS.—The Collins Light & Power Company, of Collins, has been incorporated with a capital of $10,000. Incorporators: W. E. Payne, H. Swinney and others.

LITTLETON, N. H.—The house has passed a bill authorizing the town to establish or acquire an electric light plant and water works.

BINGHAMTON, N. Y.—Aldermen Fetherolf, Stephenson and Hewett have been appointed a committee to investigate the question of municipal ownership of an electric light plant.

BUFFALO, N. Y.—The Lamp Committee of the Board of Aldermen recommends that the Commission of Public Works be authorized to enter into a 5-year contract with the Buffalo General Electric Company, which offers to furnish 4,000 lamps at $70 per lamp per year. If the city accepts this offer, electric light will be substituted for gas light throughout the city.

SCOTLAND NECK, N. C.—The town of Scotland Neck has voted bonds for electric lights. Dr. J. E. Shields is mayor.

CHARLOTTE, N. C.—The Highland Park Mfg. Co., of Charlotte, will erect a $100,000 electric plant to operate a new $500,000 cotton mill. Two thousand horse-power will be developed.

ELIZABETH CITY, N. C.—A charter has been granted to the Elizabeth City Light & Power Company, which has a capital of $100,000, and the Elizabeth City Water & Power Company, with a capital of $100,000. The incorporators of both companies are David B. Banks and M. W. Offut, of Baltimore, Md., and C. M. Ferebee, of Elizabeth City.

FOSTORIA, OHIO.—W. T. Mills, of Columbus, is said to be preparing plans for an electric light plant.

TOLEDO, OHIO.—The Toledo & Interurban Railway Company is to be incorporated under the laws of Ohio to build a line from Pioneer to Goshen, Ind.

MEDINA, OHIO.—The plant and business of the Medina Electric Light & Power Company has been sold to a Cleveland company. Improvements will be made.

BARBERTON, OHIO.—The Barberton Inn Company is securing estimates on a 1,000-light plant to furnish light for the hotel and neighboring business blocks in Barberton.

GALLIPOLIS, OHIO.—The Gallipolis Electric Light Company has increased its capital stock from $10,000 to $30,000 and will make improvements. J. H. Moxon is general manager.

LOUISVILLE, OHIO.—The Louisville council has made a contract with the Canton Light, Heat & Power Company, of Canton, for 25 arc lamps at the rate of $60, on a moonlight schedule.

COLUMBUS, OHIO.—The city clerk has been instructed to advertise for bids on wire, poles and fixtures for the municipal lighting plant, in accordance with specifications provided by the Director of Public Improvements.

LEESBURG, OHIO.—The Leesburg Manufacturing, Light & Power Company has been incorporated, with $25,000 capital stock, by R. P. Barrett, W. E. Dibble, H. A. Leeson and others. They will erect a lighting plant.

STRUTHERS, OHIO.—The town is negotiating with several lighting concerns for electric light. Prominent local people stand ready, if given a franchise, to construct an electric light plant which shall be owned by local capital.

COLUMBUS, OHIO.—The Indianola Heating & Lighting Company is preparing to erect its plant on King Avenue. The plant will have a capacity of about 1,000 hp and will furnish steam heat as well as light throughout a large portion of the residence district of Columbus.

STROUDSBURG, PA.—It is stated that the Monroe County Water Power & Supply Company, recently chartered, will begin at once the erection of a plant, to cost $75,000. Jos. H. Schull is president.

PERKASIE, PA.—It is proposed to purchase an engine and dynamo for the electric light plant. H. B. Scheetz is clerk of the council.

EASTON, PA.—Cramp, Mitchell & Serrill, bankers of Philadelphia, are stated to have purchased a controlling interest in the gas and electric properties of Easton and Phillipsburg, N. J., and intend to consolidate them.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company is reported to have acquired privileges held by M. P. Davis for water power from the Soulanges Canal. This will supply 40,000 horse-power.

SUMPTER, S. C.—The Sumpter Ice, Light and Power Company, capital $70,000, has been chartered by Chas. T. Mason and Perry Moses.

UNION, S. C.—It is stated that a large water power plant will be established on the Broad River at Neal's Shoal, twelve miles from this place, by Mr. T. C. Duncan, president of the Union Cotton Mills, and others. It is the purpose of this enterprise to supply electrical energy for the mills, and the surrounding towns with electric light. It is also likely that a trolley line will be constructed.

MEMPHIS, TENN.—It is stated that the Memphis Electric Light & Power Company will expend about $125,000 in improvements.

CHATTANOOGA, TENN.—The Chattanooga Light and Power Company has been reorganized with $750,000 capital. Improvements involving about $300,000, including a large new building, are being inaugurated.

AUSTIN, TEX.—It is reported to be the purpose of the Austin Light, Heat and Power Company, recently incorporated under the laws of Delaware with a capital of $2,500,000, to rebuild the great dam across Colorado River, at Austin, and to supply the city and private concerns with light, heat and power. The incorporators are Edw. C. Dowling and Harry U. Spence, of Brooklyn, N. Y., and Milard H. France, of New York City, N. Y.

SPRING CITY, UTAH.—An electric light plant is to be installed here in the spring by the Spring City Mill Company.

PARKERSBURG, W. VA.—V. B. Archer, one of the chief promoters of the Parkersburg & Ohio Valley Electric Railway, claims that his company has been financed to the extent of $1,500,000 and will build from Williamstown to Moundsville.

CHARLESTOWN, W. VA.—Stephen B. Elkins, Chas. Swisher and others are reported to have purchased the gas, water and electric light plants at Charlestown and will operate them from a single power station under the name of the Kanawha Water & Light Company. The capital stock of the new company is $600,000.

RICE LAKE, WIS.—The citizens have voted to issue $32,000 bonds to purchase the electric light plant and water works.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—It is said that the Huntsville Railway, Light & Power Company has decided to extend its lines.

SANTA ANA, CAL.—The Santa Ana & Newport Beach Electric Railroad has applied to the Council for a franchise.

WATSONVILLE, CAL.—The Watsonville Transportation Company has been incorporated, with a capital stock of $1,000,000. F. A. Kilburn, R. W. Eaton and H. H. Main are among the incorporators of the company.

HARTFORD, CONN.—The Senate has passed the bill granting a charter to the Naugatuck Valley Railway Company.

NORWICH, CONN.—It is reported that the Worcester & Connecticut Eastern Railway Company will this summer begin the construction of an electric railway between Norwich and Jewett City.

ST. ELMO, ILL.—The St. Louis & Eastern Electric Railway is seeking incorporation. Johnston Brothers, of St. Elmo, are interested.

DIXON, ILL.—The City Council has granted a franchise to G. H. T. Shaw to build an electric railway into the city from DeKalb and Lee Center.

QUINCY, ILL.—E. H. Arnold, chief engineer of the Quincy & Western Illinois Electric Railway Company, has opened offices in the Wells Building and the announcement is made that final arrangements are to be made at once for building the company's proposed lines. Bracey, Howard & Company have the contract for building.

INDIANAPOLIS, IND.—A bill has been introduced in the Senate to require interurban railway companies to employ train dispatchers.

SIOUX CITY, IA.—It is understood that the new owners of the Sioux City Traction Company plan to rebuild the entire system of the company.

LOUISVILLE, KY.—The Fiscal Court has adopted a resolution providing for the sale of a franchise for an electric railway to Valley Station and River View. The upset price is $500 per mile. It is said that a company is being organized to bid in the franchise.

LOUISVILLE, KY.—The stockholders of the Louisville Interurban Railway which will run between Louisville and Mt. Washington have organized. Mr. Charles Doherty was chosen president and John Russell, vice-president. The board authorized an increase of $100,000 in the capital stock, making it $500,000.

NEW ORLEANS, LA.—The Southern Light & Traction Company, of New Orleans, has been incorporated, with a capital stock of $500,000, to build electric railways and power plants in the interior towns of Louisiana and Mississippi. The officers are: Sol. Wesler, president; J. H. Ingwerson, vice-president; G. H. Hovey, secretary; R. J. Kennedy, treasurer.

CHERRYFIELD, ME.—Application has been made to the Legislature for the incorporation of the Cherryfield & Millbridge Street Railway Company, with a capital not exceeding $100,000. E. R. Wilson, of Cherryfield, and George A. Sawyer, of Millbridge, are interested.

WINNIPEG, MAN.—The Winnipeg Street Railway Company plans to build several extensions within the city during the summer.

CHESAPEAKE BEACH, MD.—Announcement is made of the sale of the Chesapeake Beach Railway to David H. Moffat, of Denver.

FREDERICK, MD.—It is announced that the Baltimore & Frederick Electric Railway Company has awarded the Westinghouse Company a $400,000 contract for equipment. The plan of the company is to build from Baltimore to Frederick, a distance of about 45 miles.

ATTLEBORO, MASS.—The selectmen have granted a franchise to the Attleboro & Mansfield Street Railway Company.

WORCESTER, MASS.—The Blackstone Valley Street Railway Company is considering the advisability of extending its line through Northbridge to South Sutton, Mauchaug and East Douglas.

FALL RIVER, MASS.—It is stated that a deal has been closed by the Old Colony Street Railway Company for the purchase of a large tract of land on which it is proposed to erect a new power plant.

MUSKEGON, MICH.—The Muskegon Traction & Lighting Company has increased its capital stock from $600,000 to $700,000.

LAPEER, MICH.—The Council has declared forfeited the franchise granted in 1900 to the Detroit, Lapeer & North Branch Electric Railway Company.

JEFFERSON CITY, MO.—The Senate has passed a bill declaring that electric railways in Missouri are common carriers, and placing them under the jurisdiction of the State Railway and Warehouse Commission.

TRENTON, N. J.—The Trenton, Lakewood and Atlantic Traction Company, with a capital of $1,000,000, has been chartered. The road will run from Trenton to Lakewood. The incorporators are George O. Vanderbilt and Albert D. Cook, of Princeton, Thomas P. Allen, Joseph H. Allen, Peter Schlichner, William Allfuther and Richard N. Page, of Trenton, William B. Wills, of Mount Holly, Abel B. Haring and William H. Martin, of Frenchtown, Jacob Wyckoff, of Princeton Junction, James C. Robbins, of Hamilton Square, and Albert T. Eckles, of Milford.

RIVERHEAD, L. I., N. Y.—The plan to build an electric railway to connect Riverhead, Quogue and other south side villages on the east end of the island has been revived. Wm. J. Martin and Joseph Martin are said to be interested.

ROCHESTER, N. Y.—It is understood that the Rochester & Eastern Rapid Railway Company, which now has under construction an electric railway from Rochester to Canandaigua, is negotiating for the purchase of the property and rights of the Ontario Light & Traction Company and the Canandaigua Gas Company.

NEW YORK, N. Y.—The United States Senate has passed the bill granting to the New York & Jersey Railroad Company the right to construct and operate an underground railway under and along Greenwich Street, New York, past the block bounded by Greenwich, Christopher, Washington and Barrows Streets, owned by the United States.

JAMAICA, L. I., N. Y.—The South Shore Traction Company has just been incorporated with a capital stock of $2,000,000 to build an electric railway sixty miles in length in Suffolk and Nassau Counties. The directors of the company are L. Lee Slingluff, of Baltimore, Md.; Arthur C. Hume, James A. Hawes, S. B. Thompson and C. G. Perot, of New York, F. D. Schaffer, of Hamilton, Ohio; Samuel Worthington, of Kearny, N. J.; Edward Phillips, of Brooklyn; and Chas. Hall Davis, of Petersburg, Va.

CLEARFIELD, PA.—The Centre & Clearfield Street Railway Company has organized as follows: J. G. Platt, president; O. L. Schoonover, vice-president; James Passmore, treasurer; H. B. Hartswick, secretary; James Passmore, Jacob Swires, A. J. Graham, George W. Hawtorp, C. E. Murray, J. H. Turnbach, John G. Platt, C. H. Rowland, H. M. Hughes and O. L. Schoonover, directors.

CELINA, OHIO.—Officials of the People's Rapid Transit Company which proposes to build from Toledo to Greenville, have agreed to locate the power plant at Celina.

CANTON, OHIO.—The directors of the Canton-Akron Railway Company have decided to increase the capital stock of the company for the purpose of making improvements.

URBANA, OHIO.—An ordinance is before the city council to grant permission for a street railway system to bring in a transmission circuit operating at 26,000 volts from a power station 25 miles away; the sub-station being in the center of the city.

CINCINNATI, OHIO.—Henry W. Huggins is the promoter of a new electric railway to extend from Maysville, Ky., through Georgetown and Ripley to Hillsboro, Ohio, where connection will be made with the Cincinnati & Columbus Traction Company for Columbus.

KENTON, OHIO.—The Kenton & Southern Traction Company has been organized, with J. S. Harshman, Springfield, president; R. Emery, Columbus, vice-president and secretary; S. D. McGomery, secretary. The capital stock is $600,000, with bonds for the same amount.

CLEVELAND, OHIO.—It is reported on very good authority that the Pomeroy-Mandelbaum syndicate will soon consummate a deal whereby it will obtain control of the Toledo, Fostoria & Findlay Railway, furnishing the desired Toledo connection for its Cincinnati to Toledo line.

CLEVELAND, OHIO.—The consolidation of the Ohio Central Traction Company with the property of the Mansfield, Crestline & Galion Railway pool has been effected. Officers have been elected as follows: F. T. Pomeroy, president; L. M. Coe, vice-president; M. J. Mandelbaum, second vice-president; L. M. Wolf, secretary-treasurer. The above, with F. D. Carpenter, F. L. Fuller and H. C. Lang, are directors.

SHAWNEE, OKLA.—Plans are being discussed for building an electric railway from Shawnee to Tecumseh. Wm. Edwards is said to be interested.

TORONTO, ONT.—H. B. Giveren, of Ottawa, is applying to the Dominion Parliament for a charter for another electric railway between Toronto and Hamilton.

OTTAWA, ONT.—The annual report of the Canadian department of railways and canals has been issued, and in respect to electric railways in the Dominion it shows that there were on June 30, 1902, 558 miles of electric railway completed. The paid-up capital amounted to $41,593,063, of which the municipal aid amounted to $173,000. The gross earnings aggregated $6,486,438, an increase of $718,155, and the working expenses $3,802,855, leaving net earnings of $2,683,583. The number of passengers carried was 137,681,402, an increase of 16,744,746, and the freight carried amounted to 266,182 tons, a decrease of 21,744 tons. Electric power was supplied in thirteen cases by water, and in twenty-seven cases by steam. Ontario has 334 miles of electric railway; Quebec, 140; New Brunswick, 12; Manitoba, 13, and British Columbia, 45 miles. One company has ceased operation.

PROVIDENCE, R. I.—The Pascoag & Providence Street Railway Company is seeking incorporation. Samuel Mellor, of Gloucester, and Nicolas S. Winsor, of Greenville, are interested.

PERSONAL.

DR. F. A. WOLFF, of the National Bureau of Standards, Washington, is to discuss "Modern Methods of Electrical Standardizing" before the Franklin Institute, on March 26.

MR. C. O. MAILLOUX is lecturing this spring before Harvard and Lehigh Universities on the subject of train resistance, of which, as is well known, he has made a special study.

MR. ROBERT WATSON, patent lawyer and solicitor in Washington, has removed his offices in that city to the McGill Building, 908 G Street, where he will be glad to see old electrical friends and acquaintances.

MR. R. J. HEWETT, of St. Louis, has taken service with the Hall Signal Company, New York. Mr. Hewett has for a number of years been connected with the telegraph department of the Missouri Pacific Railway Company.

MR. C. J. FIELD has returned to the conduit field and is again handling vitrified and glazed clay conduits, as the sole agent of two large factories "outside the combination," with headquarters at 29 Broadway, New York.

MR. CHARLES M. SCHWAB, president of the U. S. Steel Corporation, has given the Automobile Club of America sufficient steel plates to lay nearly a mile of track, to test the adaptability of a steel plate roadway for automobiling.

MAYOR SETH LOW, on March 14, drove the first spike in the rails of the New York Subway road. It was a silver spike which will be preserved and given to the mayor with an inscription. The scene was the Columbus Circle station at West Fifty-ninth Street.

MR. B. B. WHITE, formerly superintendent of the city of Thomaston lighting and power plant, is now superintendent of the city of Starke, Fla., electric light and water plant, where he hopes to enhance his record as an electrical and mechanical engineer.

MR. W. W. BRADFIELD, the engineer in charge of the Marconi wireless telegraph installations in the United States, sailed last Saturday on the *Umbria* for England, to complete arrangements for an extensive system of wireless telegraphy in this country.

MR. JAMES G. BIDDLE has removed his offices from the Stephen Girard Building to Rooms 60 and 62, 1114 Chestnut St., Philadelphia, where he will have better accommodations than heretofore for giving proper attention to his business in high grade electrical measuring instruments.

MR. GUY W. BUXTON, who has been for some time connected with the New York office of the H. W. Johns-Manville Co., has been recently appointed auditor of that Company, the branches of which are located in Milwaukee, Chicago, St. Louis, Pittsburg, New Orleans, Cleveland, Boston and Philadelphia.

MR. CHAS. S. PROSSER has been appointed general sales agent of the Peerless Rubber Manufacturing Company, New York City. Mr. Prosser is fully qualified for such a position, having been five years in the factory, and five years as traveling salesman for the Peerless Rubber Manufacturing Company.

MR. HENRY NOYES, of the Australian electrical engineering and contracting firm of Noyes Brothers, Sydney and Melbourne, which represents the Westinghouse, Brill, Niles-Bement-Pond and other prominent American manufacturing concerns in that part of the world, sailed Saturday last for Europe after a short visit to the United States.

MESSRS. J. H. VAN DEN W. BAKE and W. C. Mühlhaus, Jr., of Amsterdam, Holland, are visiting this country with respect to export trade in electrical apparatus from the U. S. A. to the Low Countries. They expect to spend about six weeks in America, and are now staying at the Hoffman House. They will shortly make a Western trip.

MR. CHARLES A. BROWN, of Chicago, was the patent counsel in the recent split phase suits won by the Diamond Meter Company, and has received many congratulations upon his work and success in this difficult litigation, directed nominally against the Catskill Illuminating & Power Company, but aimed in reality at the Scheefer meter.

MR. A. E. BRANDT, who for some years past has been representing the Allgemeine Electric Company, of Germany, in Japan, China, etc., is now on his way home, passing through the United States. He is now in New York City looking up recent central station work, etc., and expects to sail for Germany about March 24, after a trip to Washington, etc.

MR. C. E. LEFEBVRE, at one time identified with electrical interests in the East, is now manager for the Engineering & Equipment Company, Bissell Block, Pittsburgh, Pa., conducting their business in supplies, construction and engineering in electrical and mechanical lines. Catalogues, printed matter, etc., for him are requested to be sent to the company endorsed "Department S."

MR. JOHN DAVIDSON, who has for some time been connected with the Germania Electrical Lamp Company, of New Jersey, has severed his connections with them and associated himself with the Sterling Electrical Mfg. Company, of Warren, Ohio, manufacturers of the Sterling incandescent lamps. Mr. Davidson operates from the New York office of this company, No. 26 Cortlandt Street, New York City.

DR. R. M. WALMSLEY, principal of the Northampton Institute, London, who is already well known in American electrical circles, is visiting the United States to study the development of technical education and of the electrical art since his last visit. Dr. Walmsley is accompanied by his sister, Miss Walmsley, who is also prominently identified with English educational work. They will probably go as far as Canada and Chicago.

MR. F. W. STILLWELL, of Scranton, Pa., is reported at Richmond, Va., dangerously ill from ptomaine poisoning. Mr. Stillwell is a brother of L. B. Stillwell, the consulting engineer, and went to Richmond to inspect the proposed improvements and additions to the Virginia Passenger and Power Plants for Frank J. Gould. After inspecting the properties, the party intended leaving for a Southern trip, but were prevented by the sudden development of illness.

MR. E. F. SCHURIG is well known as the city electrician of Omaha, Neb. The lack of appreciation felt for the services of such an important official in so large a city is shown by the fact that the Omaha charter bill introduced recently in the Nebraska legislature reduces the salary of the office from $1,800 to $1,500 a year. The higher salary was too low as it was, and it is hard to see how it is expected to secure and retain competent electrical engineers at such rates. No better way could be hit upon to impair the efficiency of incumbents of the position.

MR. CARL SNYDER.—Some time ago Mr. Snyder, a young American scientist, stirred up discussion by an article upon the inferiority of the American position in science. Since then he has been the exponent of vigorous and aggressive theories in scientific matters. This spring he will publish through Harper & Bros. "New Conceptions of Science," a volume designated to give the layman a chance to keep pace with scientific progress. Mr. Snyder is very deeply interested in electrical matters and proposes to make two or three leading inventions in new fields, if his ideas prove tenable.

MR. H. T. HARTMAN, of Philadelphia, has been asked by President Ferguson to take charge of the Question Box for the twenty-sixth convention of the National Electric Light Association, and has kindly consented to do so. It is hoped to make this a very prominent feature of the convention programme. The desirability of all members contributing both questions and answers at an early date need not be emphasized. The success and utility of the Question Box last year was remarkable, and it is believed that Mr. Hartman's intelligent efforts this year will elicit a great variety of valuable information.

MR. W. C. GOTSHALL, president of the New York & Portchester road, which has just received a decision confirming its charter granted by the railroad commission of New York, says: "This, of course, is only the beginning of a mass of legal work which has to be accomplished before we begin the actual construction work next June. Our present capitalization, which was only a temporary one, is $250,000. We intend shortly to make an application to increase this to $16,000,000, the actual value of our road when completed. Almost the entire right of way from New York to Portchester has been purchased, and we are only waiting till we are through with our preliminary legal work. Negotiations are now under way between us and the Subway people for a traffic understanding."

MR. JOHN I. SABIN, president of the Chicago Telephone Company and the Central Union Telephone Company, who went to Chicago two years ago from the Pacific States, announced at the directors' meeting, March 13, his unwillingness to serve as president of these companies any longer than is strictly necessary. He wishes to return to San Francisco. Mr. Sabin consented to serve until a successor could be selected and the affairs of the president's office are turned over to the new man. During Mr. Sabin's administration there has been an enormous expansion of the business of both companies of which he is president. In fact, the Bell interests in the Central States have been very much rejuvenated. The capital investment has been increased and the growth in revenue and subscriptions has been very large. In fact, the companies have been taxed to take care of the business offered.

MR. CLOYD MARSHALL has been appointented Superintendent of Electrical Machinery in the Department of Electricity of the Louisiana Purchase Exposition. The electrical and engineering training which Mr. Marshall has received has well fitted him for the work he has now undertaken. After graduating from the school of electrical engineering of Purdue University in 1895, he was retained as assistant in the electrical laboratory. Later he accepted the position of electrical editor of the *Street Railway Review*, of Chicago, and, during the period of this connection, from 1896 to 1898, he served as secretary of the Chicago Electrical Association. Mr. Marshall for two years held the position of designing and testing engineer for the Jenney Electric Manufacturing Company, and then took up experimental work for the Railway Materials Company, of Chicago. In 1901 he accepted the position of plant engineer, and, later, of engineer of the sales department of the C. W. Hunt Company, of New York. The latter position he has just resigned to accept the appointment of the World's Fair Directors.

NEW INDUSTRIAL COMPANIES.

THE OHIO TIE COMPANY has been incorporated at Lucasville, Ohio, with $12,000 capital stock, by C. A. Little and others. The company will manufacture railway ties and timber.

THE AMERICAN MINIATURE AND DECORATIVE LAMP COMPANY has been incorporated with a capital of $100,000. The directors are H. J. Jaeger, C. Hubert and Samuel Stern, of New York City.

THE UNITED ELECTRIC COMPANY has been organized in Detroit, Mich., to manufacture electrical appliances. The capital stock is $100,000. Among the names of those interested are A. H. Gaukler, Robert Kuhn.

THE SCHLICHT COAL SAVING COMPANY, of Greenport, L. I., N. Y., with a capital stock of $100,000, has been incorporated. Among the directors are L. L. Lewis, V. P. Donihee and R. H. Jaeger, of New York City.

THE AMPERE ELECTRO-CHEMICAL COMPANY, of Portchester, N. Y., has been incorporated, the capital stock being $200,000. Messrs. H. C. Mortimer, Jr., and C. W. Barnaby, of New York, and W. H. Miller, of East Orange, N. J., are the directors.

THE DE FOREST WIRELESS TELEGRAPH COMPANY OF CANADA has been incorporated with a capital stock of $2,500,000. The company's headquarters will be in Toronto and the provisional directors are Alexander McKenzie, E. G. Long, Charles V. Bennett and W. H. Templeton, all of Toronto.

THE W. J. BARR MANUFACTURING COMPANY, Cleveland, Ohio, capital stock $10,000, has been incorporated by W. J. Barr, T. E. Barr, W. F. Atterholt, J. W. Burrell and Wm. E. Patterson. The company succeeds the firm of W. J. Barr, which for a number of years has conducted an extensive business in the manufacture of telephone transmitter arms and other telephone specialties. With increased capital it is proposed to expand the business.

LEGAL.

TELEGRAPH POLES ON INDIANA HIGHWAYS.—The Indiana legislature has passed a bill allowing telephone companies to set their poles in all highways outside of cities and towns, without obtaining anybody's consent, provided that they are erected and maintained in such a manner as not to incommode the public in the use of the road or interfere with the ingress and egress from any premises. The bill was defeated a few days previous; but, on reconsideration, was passed. In the meantime Judge Hord, of the Bartholomew Circuit Court, decided a case in which he held that the poles of the company in question were an obstruction, and entered a fine of $100 against the company. Ninety-five per cent of telephone poles in Indiana are on public highways, and every one of these would have been involved as a result of Judge Hord's decision had the case gone to the Supreme Court and been there sustained. For the first time in the history of Indiana telephony the representatives of the Bell Company and the independent companies united in a common cause in asking for legislative relief, and worked in harmony for the passage of the bill, which was finally accomplished.

OBITUARY.

MR. WILLIAM DU BOIS, of Albany, chief electrician of the Delaware and Hudson Railroad, died in Plattsburg, N. Y., on Monday, March 16. The week before, he was thrown from a carriage, sustaining a compound fracture of the leg and internal injuries. He was about forty-two years of age, and leaves a widow and two children.

MR. J. H. HERRICK.—The death occurred in New York City last week of Mr. J. Hobart Herrick, due to a fall at the Union League Club, from sudden faintness. He was 69 years of age. He was a graduate of New York University and succeeded his father in the conduct of a large grain business. After his father's death Mr. Herrick formed the firm of J. H. Herrick & Co., grain and produce brokers, and continued in that business until 1889, when he entered the Edison General Electric Company as vice-president. When the General Electric Company was formed, in 1892, Mr. Herrick went with that corporation, also as vice-president, but left it the following year. He was for years one of the prominent members of the Produce Exchange. Prior to his election as president he had been chosen time and time again a manager of the Exchange, and he had served on its important committees. A director of the Mutual Life Insurance Company, he served also as one of the auditors.

MR. E. A. DARLING.—E. A. Darling, the general superintendent of the Edison Cement Company, whose works are at New Village, N. J., died there on Sunday last, aged 37 years, of the effects of burns received by the explosion of pulverized coal at the works on March 2. He is the ninth victim to lose his life by that accident. His father is F. H. Darling, of 126 West 123d Street, New York. A brother, Thomas Darling, also survives with his mother and two sisters. Mr. Darling was a widower. On the day of the accident he had just finished directing men in putting out a fire in the coal room. Seeing a bucket containing coal which was afire being carried into the blowing department and knowing that an explosion was sure to follow if the live coals reached the room, he tried to stop it, but failed. Then as an employee followed the bucket, he called to him to fly. Mr. Darling, however, did not heed his own warning and was terribly burned by the explosion, which occurred a second later. His body was brought to New York for burial. Mr. Darling was born in Jersey City in 1865. He received his education in Cooper Institute and Cornell University. He was a member of the Cornell Club, the American Society of Mechanical Engineers, and of the Society of Phi Delta Phi. He was at one time mechanical superintendent at Columbia University. He was a man of most engaging personality, and his death will be severely felt by a wide circle of friends.

E. B. ARNOLD.—We regret to report the death of Mr. Everton Burritt Arnold, which occurred March 9, at Loch Haven, Pa., from typhoid pneumonia, after an illness of ten days. For a number of years Mr. Arnold was associated with his brother, Mr. B. J. Arnold, and of recent years has had charge in a confidential capacity of the finances and work of the Arnold Electric Power Station Company. Mr. Arnold was born in Ashland, Neb., thirty-one years ago, and received his education in the public schools of that place and Hillsdale College, at Hillsdale, Mich. From 1893 to 1895 he had charge of the factory of the Pumpelly-Sorley Storage Battery Company in Chicago. Since 1895 he had been connected with the Arnold company in the capacity mentioned. His duties kept him out of town most of the time, and he supervised the business end of the construction of many important installations carried out by the Arnold company, such as the Chicago and Englewood storage-battery road, the Chicago and Milwaukee electric railway, the Baring Cross shops of the St. Louis, Iron Mountain and Southern Railroad, at Little Rock, Ark., the Lansing (Mich.), St. Johns and St. Louis electric railway and the Oak Grove shops of the New York Central Railroad at Oak Grove, Pa. He was just finishing up his work in Oak Grove when he was taken ill. Mr. Arnold was a young man of high principle and excellent capacity. He was noted for an extraordinary aptitude in mental numerical calculation, and his grasp of all business details was precise and accurate. He possessed the fullest confidence of his friends and associates and his services were of great value to his employer. He was unmarried.

Trade Notes.

THE WESTERN TUBE COMPANY, of Kewanee, Ill., which was one of the first users of Nernst lamps, is now displacing all arc and incandescent lights in favor of the new illuminant.

VALVES.—Jenkins Bros., 71 John Street, New York, in their 1903 pamphlet, describe and illustrate their very complete line of valves, disks, packing, etc. A complete telegraph code is given to facilitate ordering these goods.

PLAIN MILLING MACHINES constitute the subject of the Garvin Machine Company's catalogue No. 2, of recent issue. Machines of various sizes are illustrated, each illustration being accompanied by a few descriptive facts.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out an up-to-date transformer catalogue. It describes the new Packard vacuum process of transformer insulation. In sending for a copy ask for transformer catalogue "G."

ELECTRIC HOISTS.—The C. W. Hunt Company, of West New Brighton, Staten Island, N. Y., is sending out a pamphlet describing and illustrating its electric hoists. Those in this line of work will find information of interest in this pamphlet.

LINOTYPE MOTOR.—The linotype motor of the Jenney Electric Manufacturing Company, Indianapolis, Ind., is the subject of a neat booklet just issued by the company. The features of this machine are pointed out and practical applications are illustrated.

THE WARD LEONARD ELECTRIC COMPANY reports a large increase of orders for motor controlling panels for the Navy, fulfilling specifications of the Bureau of C. & R. Also large orders for its PU type circuit breaker which is being used largely for alternating current.

SPON & CHAMBERLAIN, the technical book publishers, who for the past 15 years have been at 12 Cortlandt Street, New York City, have moved nearer the heart of the mechanical and engineering district, and have taken offices in the Liberty Building, 123 Liberty Street.

THE YOST ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, has purchased a building site and will erect a large factory for the manufacture of several specialties, among them electric lamp sockets. The factory at present occupied by the company has been found too small.

THE HANSEN CAR COMPANY has been incorporated at Cleveland, Ohio, with $25,000 capital stock, by R. Hansen, M. L. Thomson, F. H. Gould, G. A. Gaston and C. K. Fauver. The company will manufacture street car bodies and automobile bodies. It succeeds the business heretofore conducted by R. Hansen.

THE CENTRAL ELECTRIC CONSTRUCTION COMPANY, recently incorporated at Youngstown, Ohio, with $20,000 capital stock, to manufacture motors and electrical supplies, has secured a building site in Struthers and will commence work at once on two buildings. W. L. Goodhart, of Youngstown, is manager of the company.

BULLOCK APPARATUS.—The Bullock Electric Manufacturing Company, Cincinnati, Ohio, in a leaflet shows two fine illustrations of "Bullock" direct and alternating current machines, water-wheel driven. On the reverse side of the sheet are reprinted three letters from the managers of plants regarding the satisfactory operation of their Bullock apparatus.

MESSRS. BARDONS & OLIVER, manufacturers of turrett lathes and other machine tools, Cleveland, Ohio, whose plant burned down some months ago, have leased the factory at No. 1 Water Street. Machinery will be operated by electricity and a number of motors will be installed. The Cleveland Engineering Company is doing the electrical engineering work.

THE SCHOEMAN ELECTRIC MFG. CO., Alleghany, Pa., expects to move its works and office to the large and commodious building at Berlin St. and P. R. R., East End, Pittsburg, about April 1. This step has been rendered necessary by the demands of its rapidly increasing business. With the new facilities at its command, it will be prepared to manufacture promptly all kinds of switch and panel boards, knife switches, etc.

TRAVELING CRANES.—In a very completely illustrated catalogue, recently issued by the Northern Engineering Works, Detroit, Mich., their standard types of cranes in more frequent demand, are very artistically illustrated and their features and advantages briefly pointed out. Actual installations of these cranes are illustrated. These machines are made in standard capacities, ranging from 100 tons down to 1 ton, and spans and lifts are made to suit locations.

STATIONARY INDUCTION APPARATUS.—The Kuhlman Electric Co., Elkhart, Ind., makes a complete line of transformers, potential regulators, auto-transformers, reactive coils and spark coils. These transformers are fully described and illustrated in a pamphlet recently issued by the company, and various curves illustrate their performance. The company keeps stocks of transformers at Denver, Col., Kansas City, Mo., and Waco, Tex., as well as at headquarters.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., is erecting a new factory which will give it more than double its present manufacturing capacity and in a large measure better enable it to meet the demand for "Sumterfones" and switchboards. The company manufactures complete equipment for interior local exchanges and long distance service. A folder recently issued contains illustrations of apparatus of various designs manufactured by the company. Descriptive bulletins and prices can be obtained on application.

DROP FORGINGS.—J. H. Williams & Company, of Brooklyn, N. Y., in their catalogue for 1903, illustrate their complete line of drop forgings of iron, steel, copper, bronze and aluminum. The articles illustrated are briefly described and tables giving dimensions and prices of the articles accompany them. Apart from the descriptive matter, the pamphlet contains some very handsome illustrations, three etchings at the front giving an exterior view and two interior views of the work. At the back are several full-page illustrations, showing samples of the great variety of articles produced by this firm.

MECHANICAL BOILER CLEANER.—The problem of keeping steam boilers clean is one that confronts every steam user, and many have been the devices designed to accomplish this desirable result. The Garrigus mechanical boiler cleaner manufactured by the Mechanical Boiler Cleaner Company, Chicago, Ill., is claimed to be successful in keeping boilers clean and free from scale, mud and oil. The cleaner removes all impurities and foreign matter from the water before they settle. In a pamphlet issued by the company many interesting facts concerning the device are given, together with copies of letters from users of this cleaner testifying to the satisfactory results obtained.

STANDARD VITRIFIED CONDUIT COMPANY, 39-41 Cortlandt St., New York City, has just issued an admirable trade pamphlet in small quarto size, the cover of which resembles exactly in color, shape, etc., a couple of sections of conduit. It is a handsome piece of cover work. Inside, the contents are equally interesting and are displayed with corresponding taste. Very full details are given as to all parts of the work, and engravings are used freely, so that the book might well serve as an exposition of the conduit art as practiced in America. The company is to be heartily congratulated upon its literature as well as upon its success with the conduit to which the pamphlet is devoted.

"SOME TELEPHONES."—Under this title the Utica Fire Alarm Telegraph Company, Utica, N. Y., has just brought out a pamphlet which describes and illustrates the company's line of telephones and telephone accessories. The pamphlet is divided into two main parts, the first being devoted to telephones and the second to telephone specialties. In the first part are described and illustrated seven different styles of wall sets, a private line telephone and an intercommunicating set. Among the specialties shown are magneto boxes, linemen's testing sets, extension bells, ringers, lightning arresters, etc. The text is printed on heavily coated paper and the front cover contains a neat design of a telephone.

METAL-WORKERS' CRAYONS.—All workers in iron and metal goods will be interested to learn that the D. M. Steward Mfg. Co., Chattanooga, Tenn., manufactures a line of crayons and pencils, especially adapted for marking on iron. The marks, it is stated, do not disappear when used on iron and heated. These goods are made in various forms—round, square and flat, and it is stated that they meet the requirements of metal workers in a very satisfactory manner. Two grades of goods are made, the "genuine" and the "compo," the latter being a composition which is similar in appearance to the genuine. A booklet issued by the company gives illustrations and prices of the various styles of pencils and crayons.

PASS & SEYMOUR SPECIALTIES.—Mr. John W. Brooks, Western Sales Agent for Pass & Seymour, Inc., with headquarters at 130 West Jackson Boulevard, Chicago, has just returned from a Western trip extending over two months. He reports great success with the new brass socket Pass & Seymour are placing on the market, having booked orders for over 100,000 sockets. The socket seems to supply a long felt want as it is "double pole." Mr. Brooks

also has recently made contracts with the Kuhlman Electric Co., Elkhart, Indiana; Maloney Electric Co., St. Louis, Mo.; Fort Wayne Electric Works, Fort Wayne, Ind.; Gregory Electric Co., Chicago, covering their year's requirements for the popular P. & S. transformer cut-out.

BITUMENIZED FIBRE CONDUIT.—A very handsome pamphlet has been issued by the American Conduit Company, of Philadelphia, Chicago and Los Angeles, setting forth the merits of its bitumenized fibre conduit for electrical work. This make of conduit is stated to be electrolysis-proof, non-abrasive, moisture-proof and non-corrosive, as well as possessing high insulating qualities, and it would seem from this that every essential requirement in a conduit is embodied in this one. The pamphlet furnishes some interesting reading on the subject of underground electrical work, giving a résumé of the development from the earliest methods of placing conductors underground out of harm's way, to the present highly-developed conduit systems. The experience of years has indicated what essentials a conduit should possess, and it is claimed that the bitumenized fibre conduit as manufactured by this company meets every requirement that actual practice has demonstrated as necessary. Various illustrations throughout the pamphlet show views of underground installations in various cities and sections of the conduit. The cover is of handsome design and exceedingly effective.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 10, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

722,212. SUBSCRIBER'S TELEPHONE-CIRCUIT; W. W. Dean, Chicago, Ill. App. filed March 22, 1902. (See page 484.)

722,249. HOLLOW TILE OR BRICK; O. C. Pixley, Chicago, Ill. App. filed Oct. 30, 1901. Terra cotta conduit sections having longitudinal grooves on the outside to receive keys for aligning the sections.

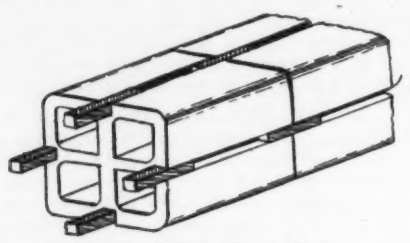
722,255. ELECTRICAL TRACTION DEVICE; B. M. Scott, Coalport, Pa. App. filed April 3, 1902. A mine locomotive having a take-up device for a flexible conductor permitting it to run into short side passages where the trolley wire does not extend.

722,301. CIRCUIT CONTROLLER; J. S. Hobson, Edgewood, Pa. App. filed July 30, 1902. Details.

722,302. AUTOMATIC GAS REGULATING VALVE; C. M. Holley and M. H. Rix, Ann Arbor, Mich. App. filed Feb. 3, 1902. A valve for gaseous fuel regulated by the action of heat on a thermostatic circuit closer.

722,334. ELECTRICAL ALARM SYSTEM; H. M. Sutton, W. L. Steele and M. Coerver, Dallas, Tex. App. filed May 25, 1901. The line wires throughout the protected structure contain independent resistances so arranged that the total resistance on each line is the same, while that at the same point on each line is different from that on the associated lines.

722,345. SYNCHRONISM INDICATOR; Jonathan E. Woodbridge, Schenectady, N. Y. App. filed July 30, 1900. One current is passed through one coil of an electro-dynamometer, and the other through the second coil.



722,249.—Hollow Tile or Brick.

722,348. TELEPHONE-SUPPORT; J. S. Young, Brooklyn, N. Y. App. filed May 21, 1902. (See page 484.)

722,362. LOCK-OUT PARTY-LINE TELEPHONE SYSTEM; C. L. Goodrum and J. W. Lattig, Philadelphia, Pa. App. filed September 12, 1902. (See page 484.)

722,367. TELEPHONE SYSTEM; J. W. Lattig and C. L. Goodrum, Philadelphia, Pa. App. filed September 12, 1902. (See page 484.)

722,379. TROLLEY POLE; H. P. Oler, Camden, N. J. App. filed Aug. 9, 1902. The trolley head is rotatable on an axis in line with the pole, so that the wheel will tilt in passing a curve.

722,411. ELECTRIC FURNACE; Albert A. Shade, of Chicago, Ill. App. filed May 15, 1902. (See page 483.)

722,446. ELECTRICALLY OPERATING DOOR; J. Chambers, Jr., Dallas, Tex. App. filed Aug. 12, 1902. Locking devices for elevator doors are controlled automatically by the movement of the car and that of the controller.

722,453. ELECTRIC CURRENT CONTROLLER; J. J. Murphey, Jersey City, N. J. App. filed Aug. 25, 1902. A terminal head for a cable carrying a number of circuits in which the terminals of each circuit are arranged side by side in a passage of the head so that a conducting push rod can be moved into engagement with any number of them.

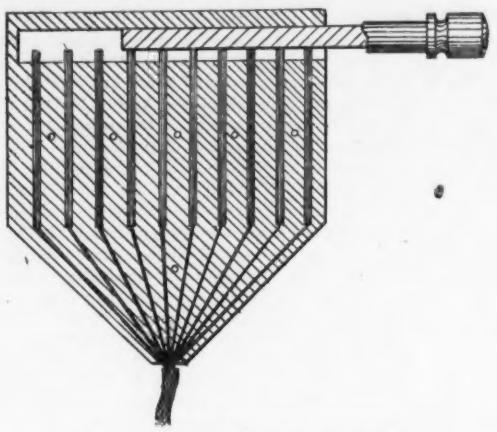
722,527. ELECTRIC CONTROLLER; F. A. Merrick, Johnstown, Pa. App. filed Oct. 14, 1902. Contacts and connections arranged to place a motor in parallel with the armature and a part of the field winding of another motor, the balance of said field winding being in series with the parallel circuit.

722,535. AUTOMATIC REGULATOR FOR CONSTANT CURRENT DYNAMOS; F. B. O'Hanlon, Portadown, Ireland. App. filed April 22, 1902. A relay adapted to reverse the action of a mechanical regulator and to weaken the field current when a flash across the brushes has occurred.

722,563. SYSTEM OF REGULATION FOR ELECTRIC MOTORS; P. J. Collins, Scranton, Pa. App. filed Dec. 18, 1899. Details.

722,583. SECONDARY ELECTRODE FOR ELECTROLYTIC APPARATUS; P. Imhoff, Liverpool, Eng. App. filed Dec. 17, 1902. An electrode built up of conducting strips placed upon the opposite sides of a non-conducting supporting plate.

722,594. ELECTRICAL INSTRUMENT FOR SURGICAL OR SIMILAR PURPOSES; M. D. Law, New York, N. Y. App. filed June 25, 1900. Details of construction of a speculum.



722,453.—Electric Current Controller.

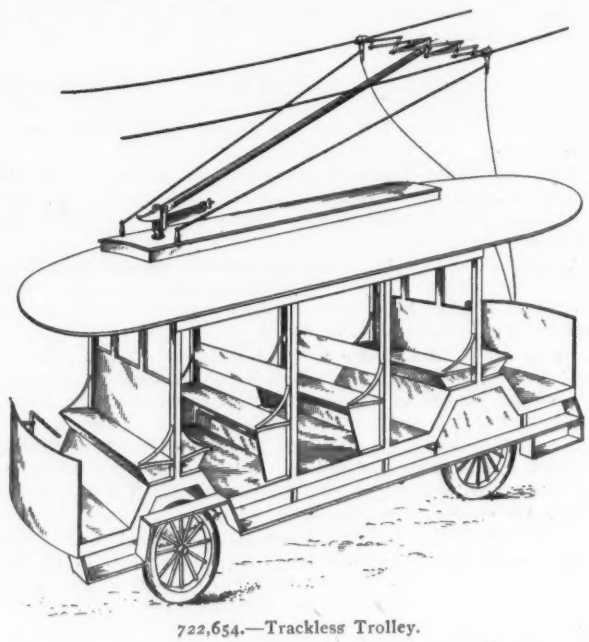
722,598. ELECTRICAL GENERATOR AND DISTRIBUTER FOR MEDICAL USE; E. L. Madden, Kanawha, Iowa. App. filed Feb. 3, 1902. Relates to the construction of a battery, belts and pads for application to the body.

722,606. ELECTRICAL CONTACT BRUSH AND METHOD OF PRODUCING SAME; H. N. Motsinger, Pendleton, Ind. App. filed Aug. 25, 1902. A carbon brush surrounded by a sleeve of copper gauze.

722,608. TROLLEY FOR ELECTRIC RAILWAYS; R. L. McCartney, Ottumwa, Iowa. App. filed Dec. 12, 1902. A device for retaining the trolley on the wire.

722,654. TRACKLESS TROLLEY; A. B. Upham, Boston, Mass. App. filed April 25, 1901. The trolley pole supports a horizontal "lazy-tongs" at each end of which is a trolley and with which the pole makes a pivotal connection, thus permitting the vehicle to wander freely considerable distances at either side of the conductors.

12,098. ELECTRIC BRAKE FOR VEHICLES; J. N. Mahoney, New York, N. Y. App. filed Jan. 8, 1901. A controller whereby current generated



722,654.—Trackless Trolley.

by the motors when disconnected from the line is utilized in a special manner to operate electric brakes.

12,099. LAMP SOCKET; D. A. Schutt, Peru, Ind. App. filed Aug. 27, 1901. Details.